

LECTURES ON INTERNAL MEDICINE PROPAEDEUTICS

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імені В. Н. Каразіна (протокол №4 від 28 березня 2016 року)*

Лекції з пропедевтики внутрішньої медицини (англійською мовою) / Яблучанський М. І., Богун Л. В., Мартим'янова Л. О., Бичкова О. Ю., Лисенко Н. В., Макієнко Н.В . за загальною редакцією
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Курс лекцій для студентів третіх курсів медичних факультетів з пропедевтики внутрішньої медицини за англійською формою навчання на англійській мові. Розглядаються підхід, методи обстеження та основні клінічні синдроми пацієнтів з захворюваннями дихальної, серцево-судинної, травної, видільної, кістково-м'язової, сполучної, кров'яної та ендокринної систем.

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Content

Lecture 1 Propaedeutics as an introduction to the clinic of internal medicine	4
Lecture 2 Approach to the patient	50
Lecture 3 Approach to the patient with disease of the respiratory system	98
Lecture 4 Approach to the patient with disease of the cardiovascular system	163
Lecture 5 Approach to the patient with gastrointestinal tract diseases	270
Lecture 6 Approach to the Patient with diseases of the hepatobiliary tract and pancreas	345
Lecture 7 Approach to the patient with affection and disease of the kidneys	437
Lecture 8 Approach to the patient with affection and disease of the musculoskeletal system and connective tissue	543
Lecture 9 Approach to the patient with affection and disease of the blood	608
Lecture 10 Approach to the patient with affection and disease of the endocrine system	674
Lecture 11 Syndromes of respiratory system diseases	746
Lecture 12 Syndromes of cardiovascular system diseases.....	838
Lecture 13 Syndromes of gastrointestinal tract diseases	1066
Lecture 14 Syndromes of hepatobiliary tract and exocrine pancreas diseases	1130
Lecture 15 Syndromes of kidneys diseases	1199
Lecture 16 Syndromes of the musculoskeletal system and connective tissue diseases	1253
Lecture 17 Syndromes of the blood system diseases	1335
Lecture 18 Syndromes of the endocrine system diseases	1427

Lecture 1

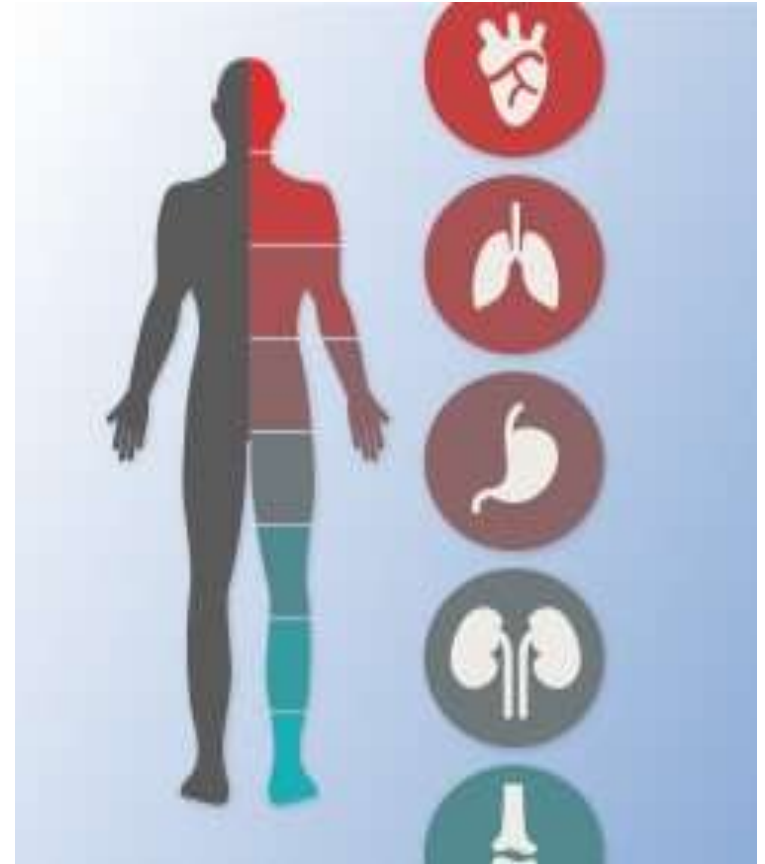
Propaedeutics as an introduction to
the clinic of internal medicine

Plan of the lecture

- Definition, purpose, objectives, method
- Foundation
- Basic Concepts
 - health, disease, epidemiology, etiology, risk factors, pathogenesis, sanogenesis, course of the disease, compensation, decompensation, outcomes of disease, diagnosis, symptoms, prognosis, treatment, prevention, quality of life, life expectancy, medical ethics, deontology
- Nomenclature *and* Classification of Diseases
- Historic foundation, present, future

Definition

- Propaedeutics (preliminary training - Gr.) - an introductory course in a speciality
- Propaedeutics of the Internal Medicine - an introductory course in the Internal Medicine



Purpose

- Epidemiology, etiology, pathogenesis, semiotics, diagnosis, prognosis, conservative (non-surgical) treatment and prevention of diseases
- Diseases of the respiratory, cardiovascular, digestive, urinary, blood, endocrine and connective tissue systems



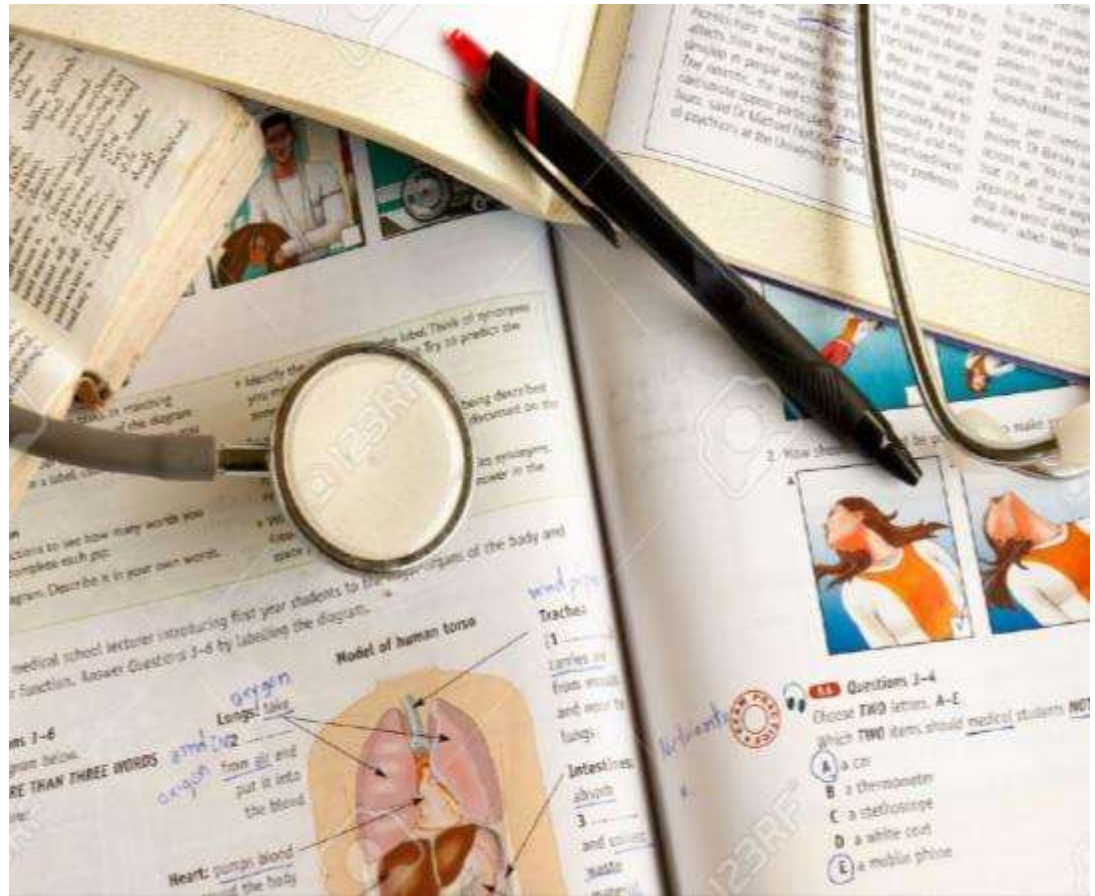
Objectives



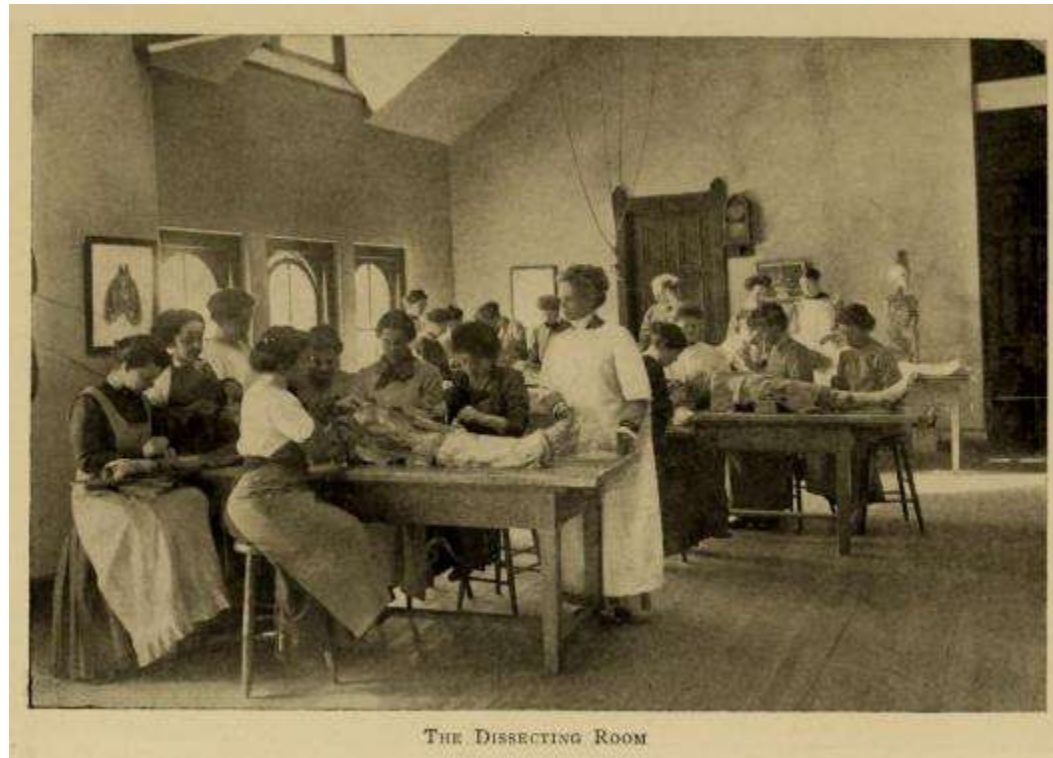
- Prepare students for the study of the Internal Medicine and for the work with a patient
- Form the clinical thinking of students as the basis of their professional activity

Method

- Self-education, hard work not only during the study of the subject, but also throughout medical practice



Foundation



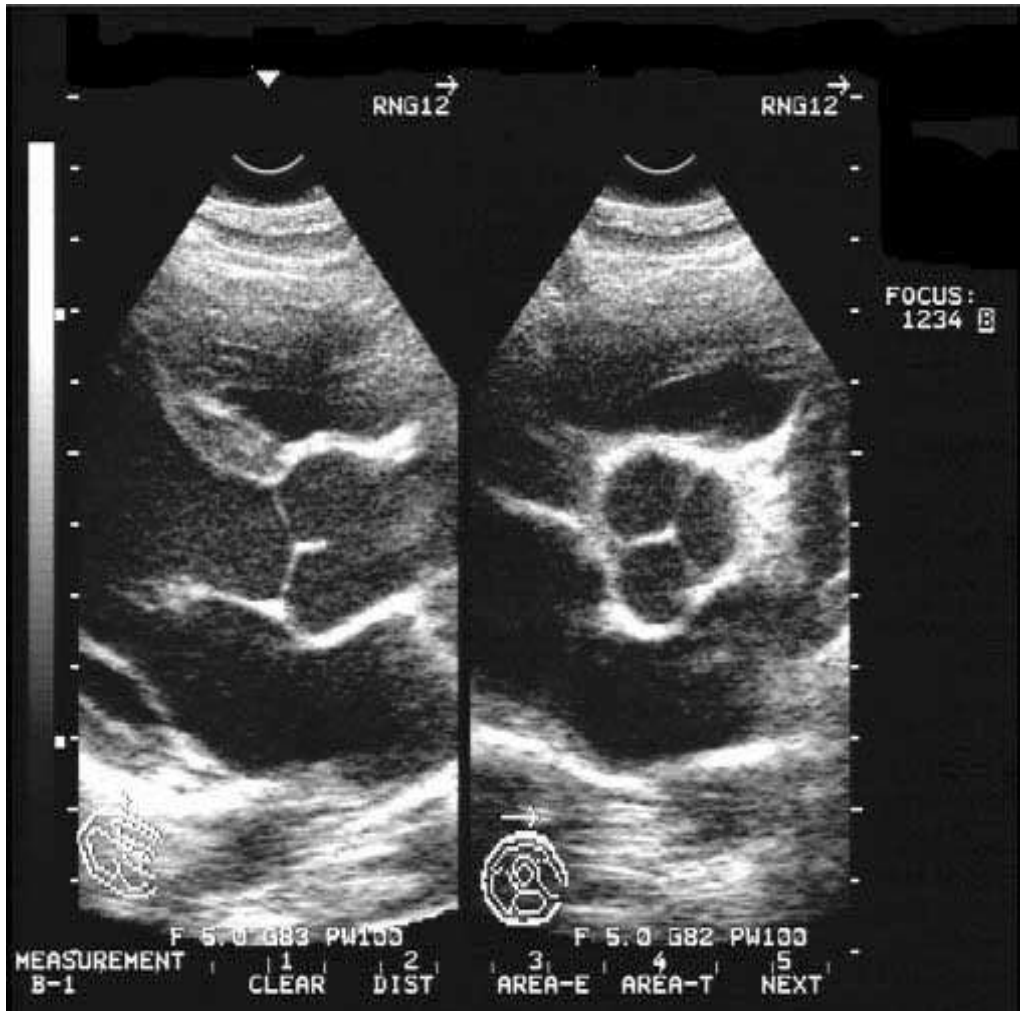
Multiplicity of medical and border knowledge, from the anatomy, histology, physiology, general pathology to the neuroscience, psychology, psychiatry, sociology, hygiene, specialized branches of the Internal Medicine

Foundation

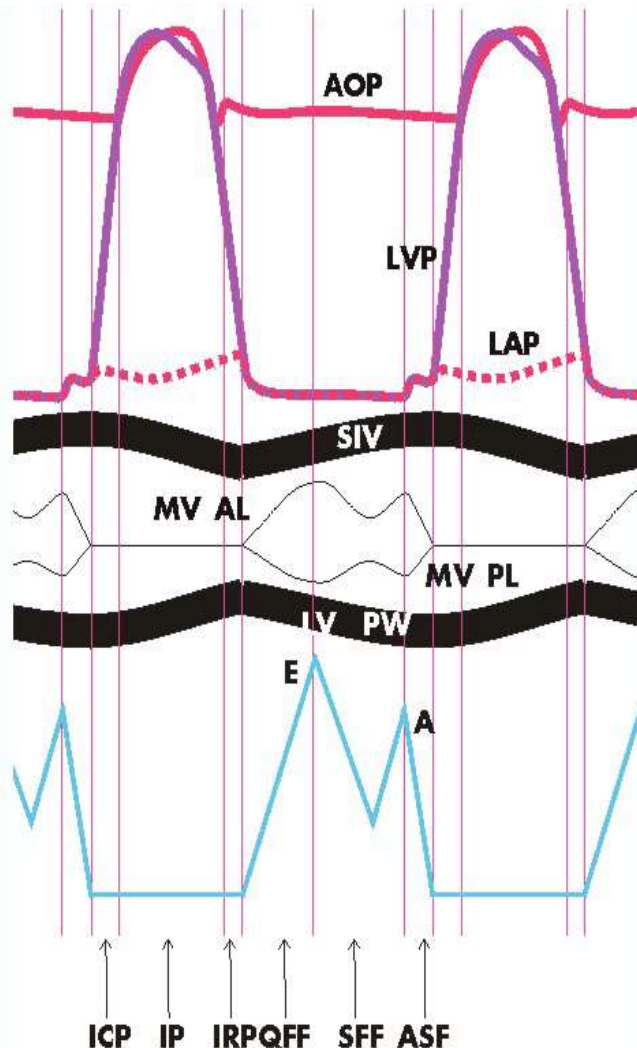
Two-dimensional echocardiography

The two mutually-perpendicular sections at the mouth of the aorta and its tricuspid valve

Good knowledge of human heart anatomy is necessary to understand the image



Foundation

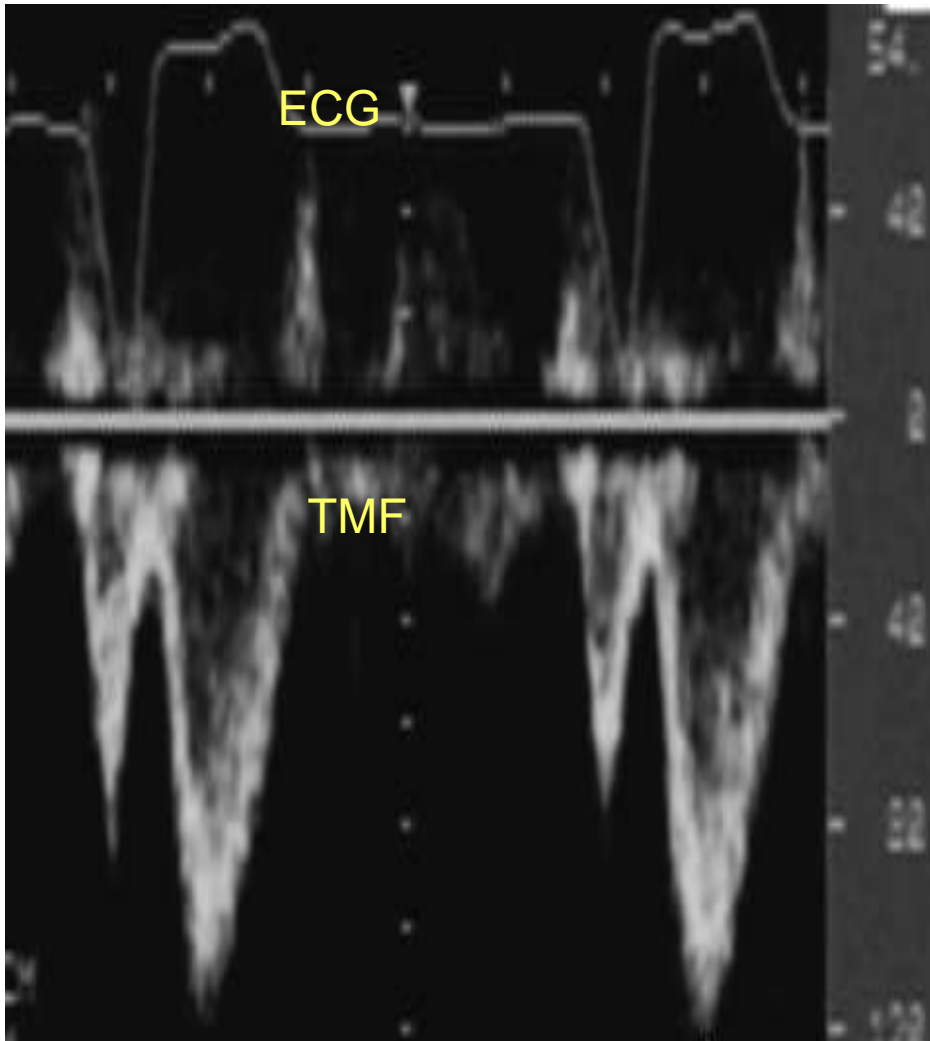


Functional curves of blood pressure changes in aorta (red continuous line), left ventricle (violet continuous line) and atrial (red dotted line)

M-Echo of left ventricular wall motion (bold black), bicuspid valve flaps (thin black), blood flow through the mitral valve (blue)

Good knowledge of human cardiovascular physiology is necessary to understand the image

Foundation

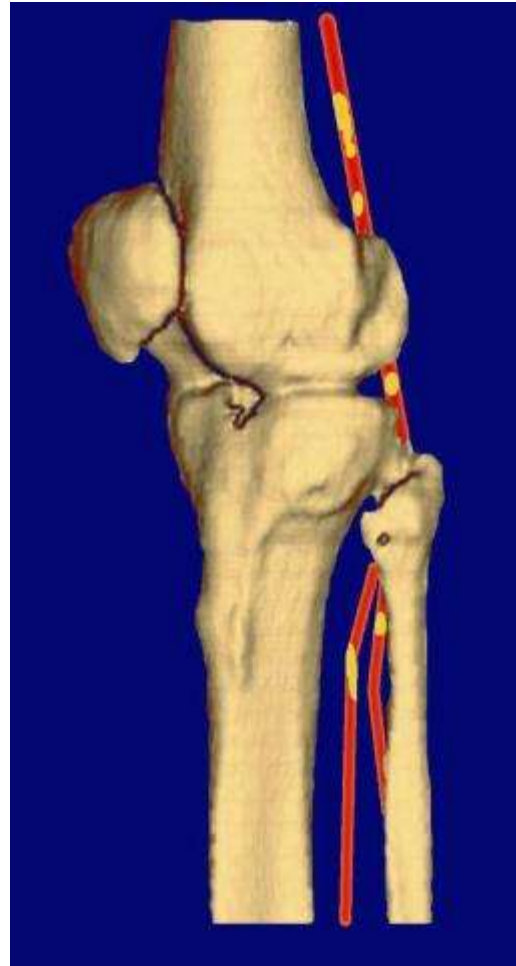
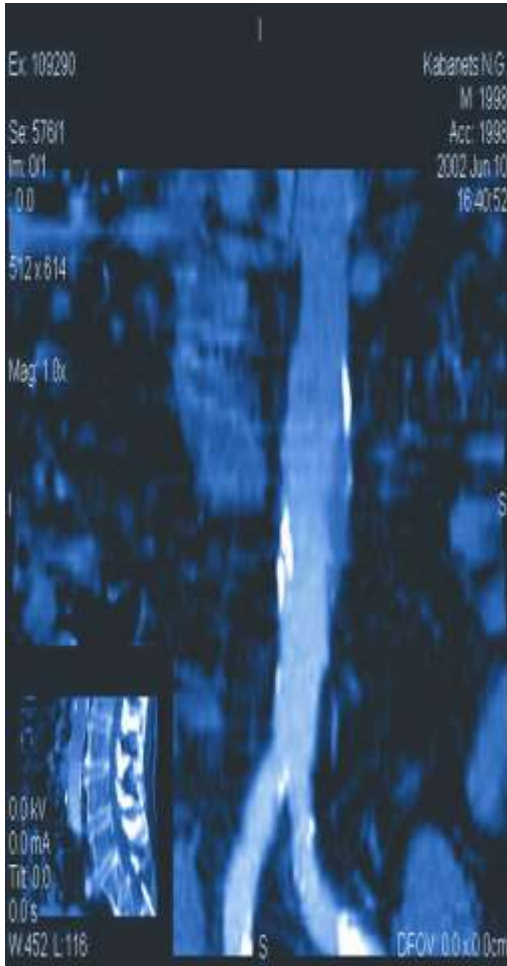


The electrocardiogram (ECG) and the Doppler echocardiographic transmitral flow (TMF)

We should not only see acute transmural changes in the left ventricular wall and violation of its diastolic stiffness, but relate these abnormalities to each other

Good knowledge of human heart physiology is necessary to understand the image

Foundation

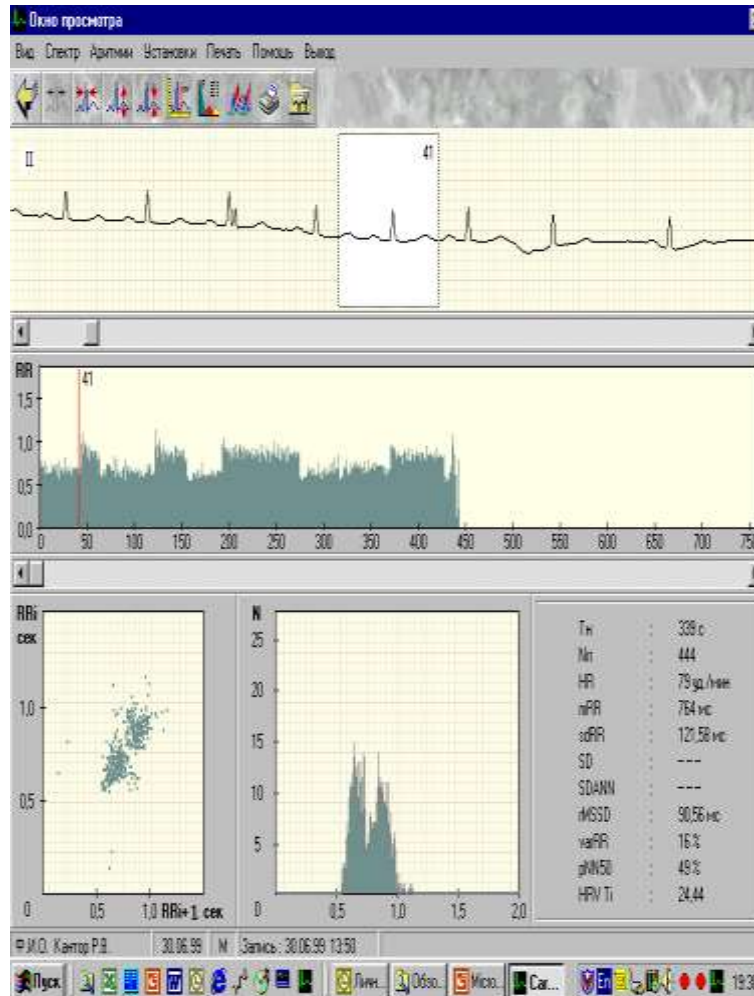


Spiral Computed tomography

Virtual geometry of anatomical structures from the cross sections to the three-dimensional reconstruction with visualization of atherosclerotic plaques affecting blood vessels

Good knowledge of human body anatomy is necessary to understand the image

Foundation



Cardiointervalography

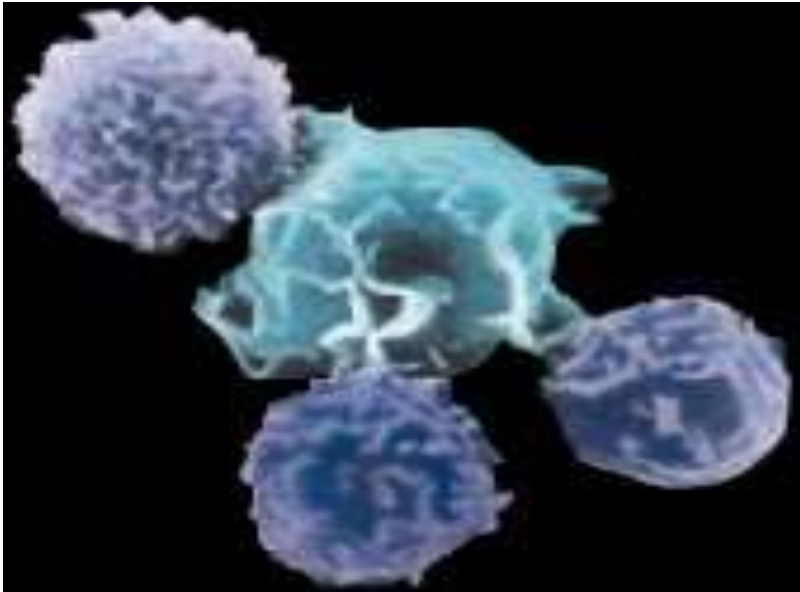
From top to bottom:

- the electrocardiogram
- RR-intervalogram
- bottom left – scattergram
- bottom right - the distribution of the lengths of RR-intervals

It is functional fractalization of the sinus node, which, by the way, has not been described yet

Good knowledge of human heart electrophysiology is necessary to understand the image

Foundation

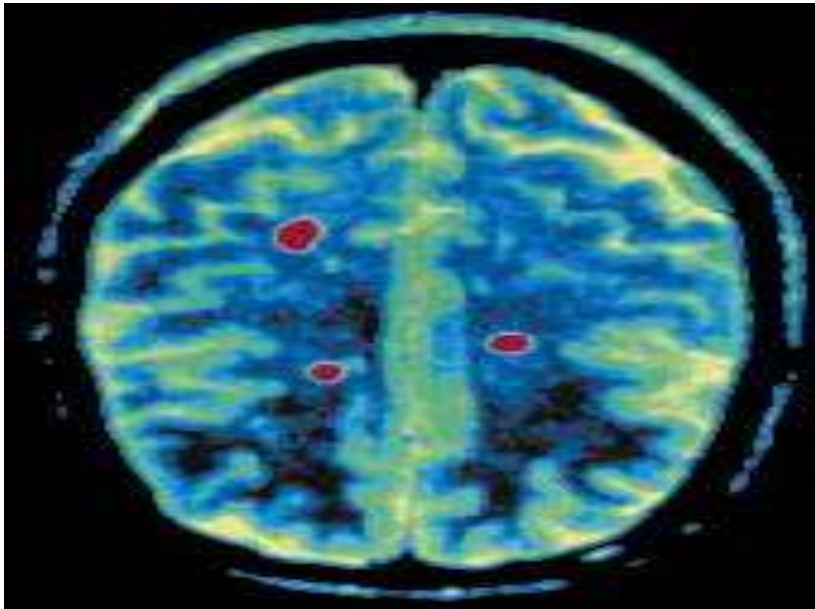


Immunocytology

Cooperating in the
immune response
cells

Good knowledge of
human immunology
is necessary to
understand the image

Foundation



Computed X-ray imaging of the brain

Clearly visible anatomical structures in the brain slice

Good knowledge human brain anatomy is necessary to understand the image

Basic Concepts: Health

- WHO definition: health is a state of complete physical, mental and social well-being and not merely absence of disease or infirmity
- Do you agree?



Basic Concepts: Disease



- A particular abnormal condition of a structure or function, that affects a part or the whole organism resulting from various causes, such as infection, inflammation, environmental factors, or genetic defect, and **is** characterized by an identifiable group of signs, symptoms, or both
- Do you agree?

Basic Concepts: Health or Disease?

Thomas Quasthoff is a German bass-baritone.

Quasthoff was born on November 9, 1959 in Hildesheim, West Germany, with serious birth defects caused by his mother's exposure during pregnancy to the thalidomide which was prescribed as an antiemetic to combat her morning sickness.

Quasthoff's height is 1.34 m (4' 4¾") due to shortening of the long bones in his legs, and he has phocomelia of the upper extremities with very short or absent long bones.



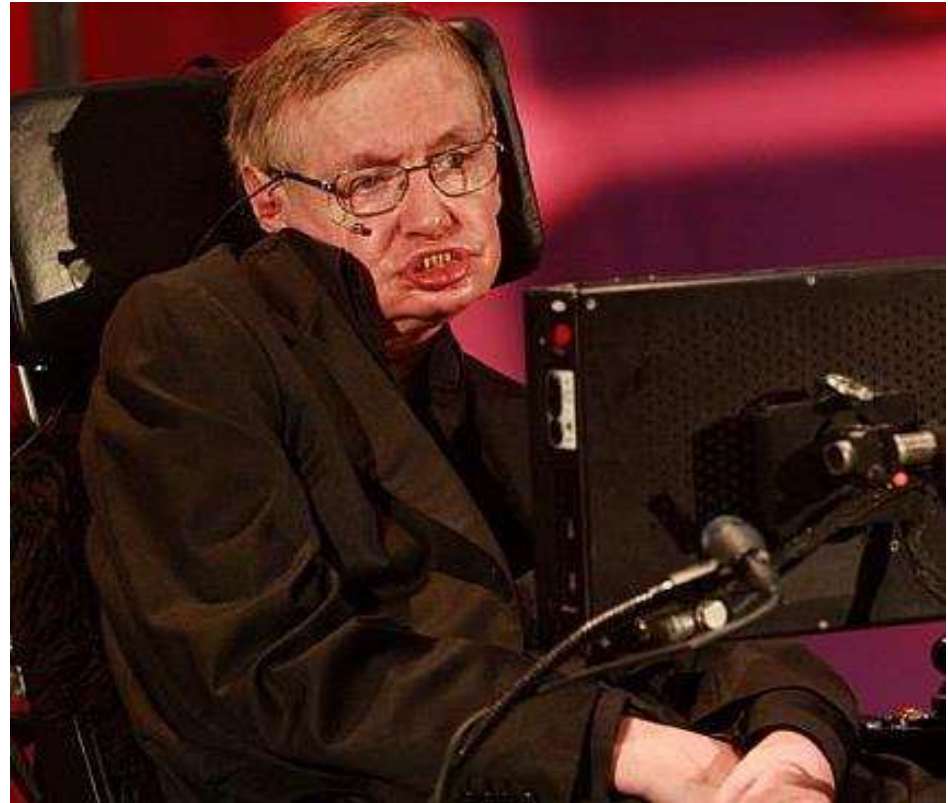
Basic Concepts: Health or Disease?

- Just one of 20 people worldwide (4.3%) had no health problems in 2013, with a third of the world's population (2.3 billion individuals) experiencing more than five ailments, according to a major new analysis from the Global Burden of Disease Study (GBD) 2013, published in *The Lancet*.
- Moreover, the research shows that, worldwide, the proportion of lost years of healthy life (disability-adjusted life years; DALYS [1]) due to illness (rather than death) rose from around a fifth (21%) in 1990 to almost a third (31%) in 2013.

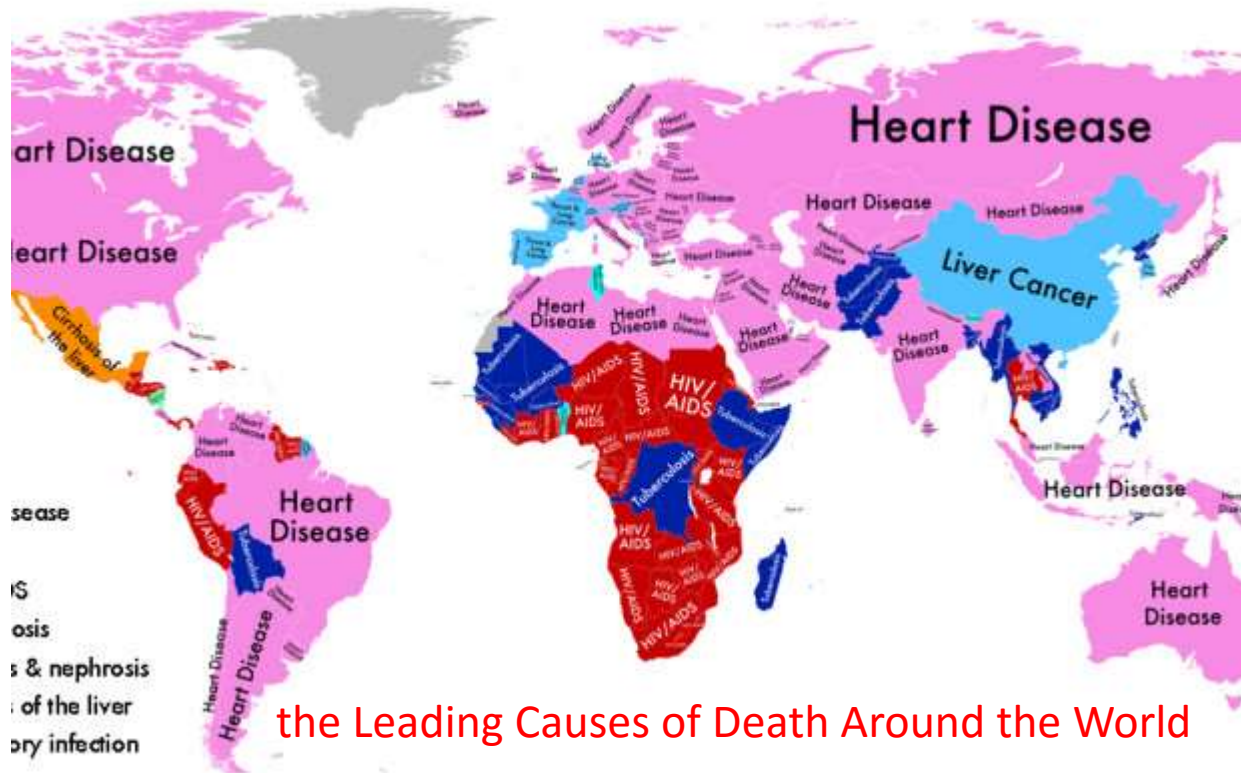


Basic Concepts: Health & Disease?

- Stephen William Hawking (born on 8 January 1942) is a British theoretical physicist, cosmologist. He was the first to set forth a theory of cosmology explained by a union of the general theory of relativity and quantum mechanics.
- Hawking suffers from a rare early-onset, slow-progressing form of amyotrophic lateral sclerosis (ALS), that has gradually paralyzed him over the decades.
- Now he communicates using a single cheek muscle attached to a speech-generating device. Hawking was married twice and has three children.



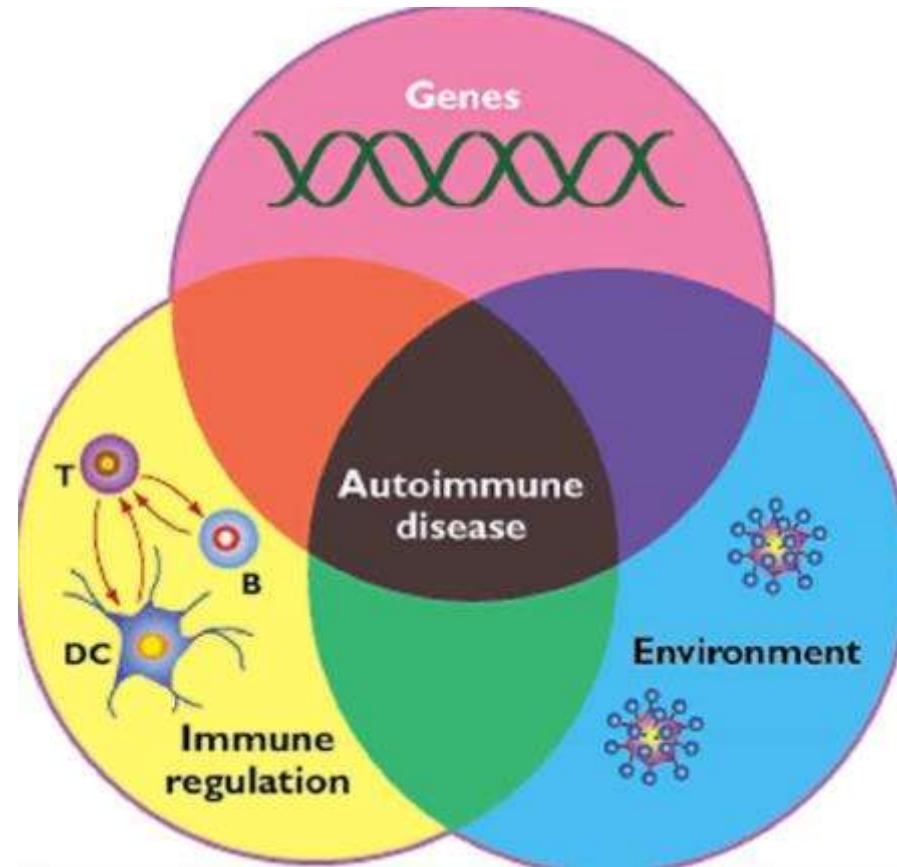
Epidemiology



- Epidemiology is the study of how often diseases occur in different groups of people and why
- Epidemiological information is used to plan and evaluate strategies to prevent disease and as a guide to the management of patients in whom disease has already developed

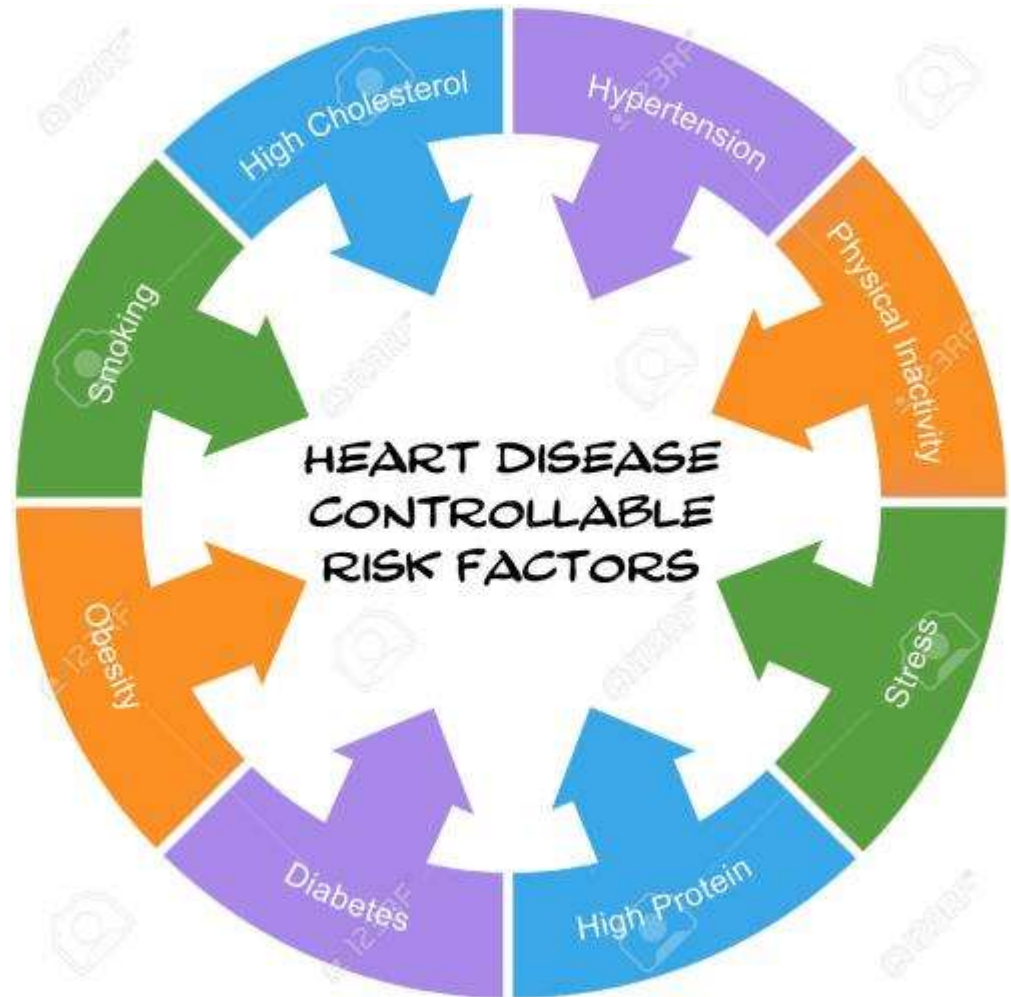
Etiology

- A cause of a disease or abnormal condition
- Where no etiology can be ascertained, the disorder is said to be idiopathic
- Usually disease' cause is determined by many factors, as in this example with an autoimmune disease



Risk factor

- A risk factor is any attribute, characteristic or exposure of an individual that increases the likelihood of developing of a disease or injury.
- Some examples of the more important risk factors are underweight, unsafe sex, high blood pressure, tobacco and alcohol consumption, and unsafe water, sanitation and hygiene



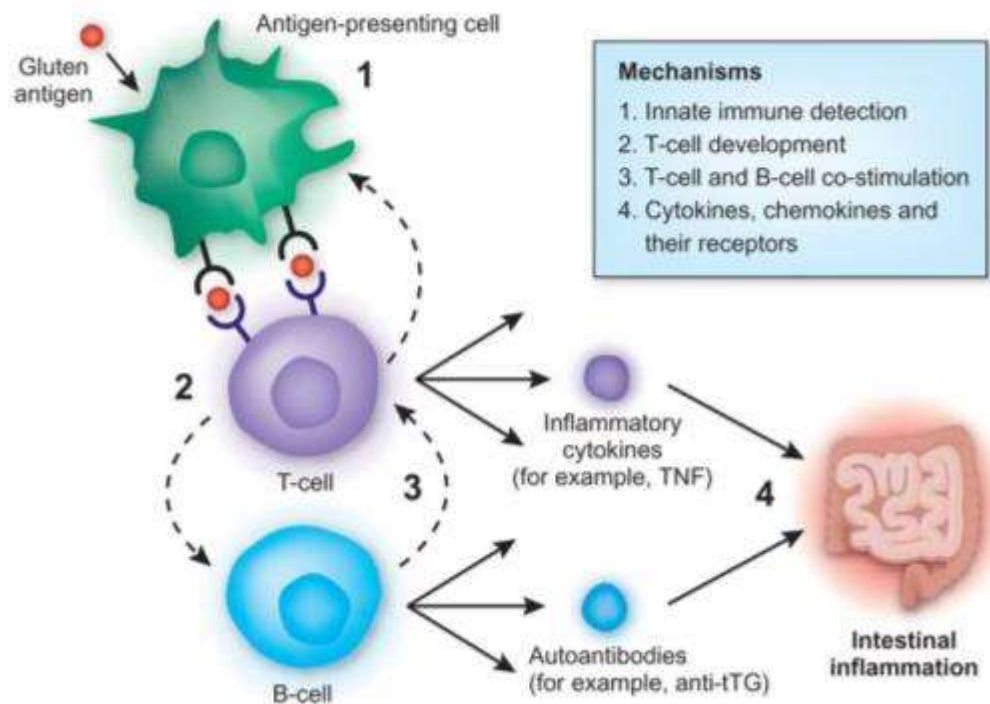
The time of the Global Somatic Risk

Other risk factors, OD or Disease	Blood pressure (mmHg)				
	Normal SBP 120–129 or DBP 80–84	High normal SBP 130–139 or DBP 85–89	Grade 1 HT SBP 140–159 or DBP 90–99	Grade 2 HT SBP 160–179 or DBP 100–109	Grade 3 HT SBP ≥ 180 or DBP ≥ 110
No other risk factors	Average risk	Average risk	Low added risk	Moderate added risk	High added risk
1–2 risk factors	Low added risk	Low added risk	Moderate added risk	Moderate added risk	Very high added risk
3 or more risk factors, MS, OD or Diabetes	Moderate added risk	High added risk	High added risk	High added risk	Very high added risk
Established CV or renal disease	Very high added risk	Very high added risk	Very high added risk	Very high added risk	Very high added risk

- Due to a significance of combination of various risk factors on the development of disease, a term risk factors has been accepted for general use instead of a singular risk factor term
- Combination of risk factors significantly exacerbates the risk of development of the disease, its severity, a possibility of early complications, and adverse outcomes

Pathogenesis

- The mechanism of disease development and the chain of events leading to that disease
- Types of pathogenesis include microbial infection etiology, inflammation, malignancy and tissue breakdown
- Most diseases are caused by multiple processes



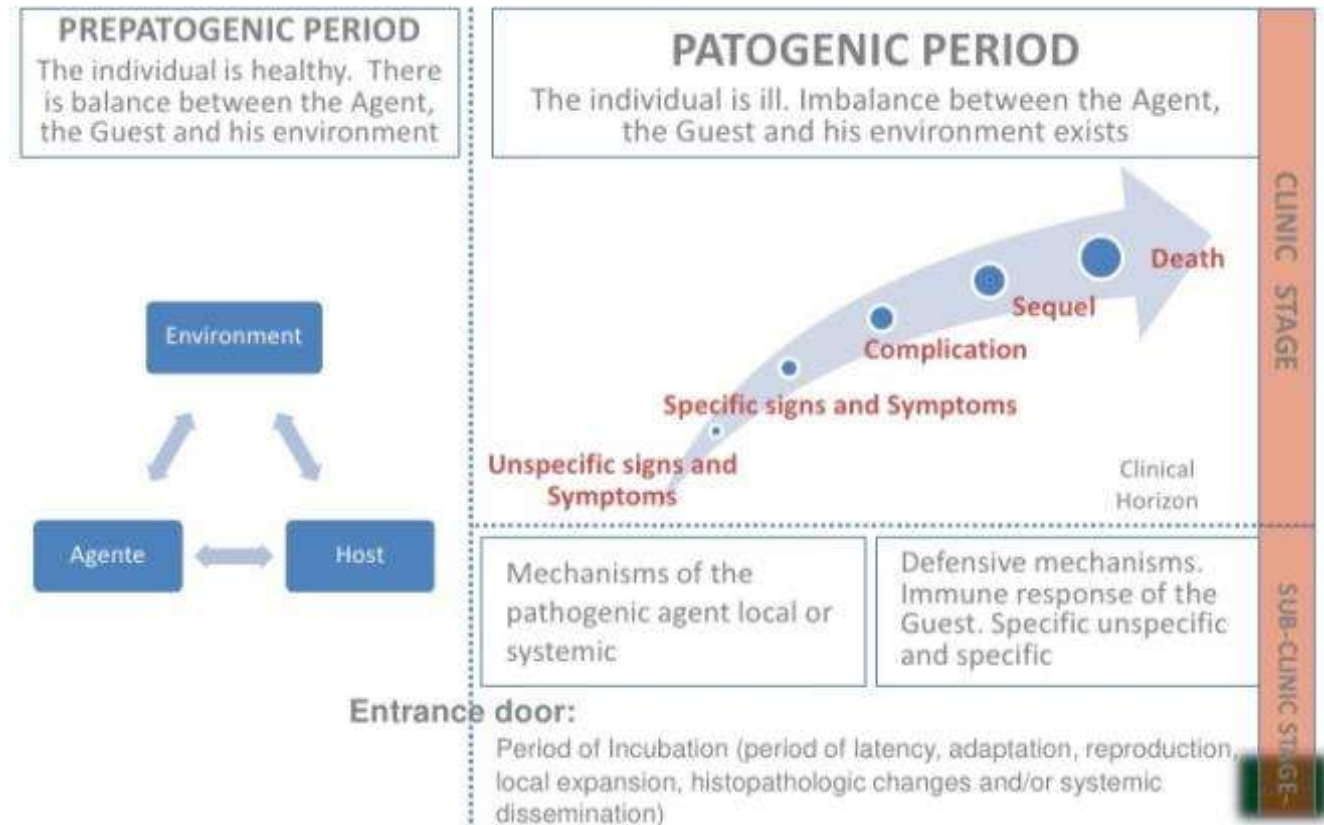
Mechanisms underlying celiac disease pathogenesis

Sanogenesis



- The mechanism of recovery from the disease
- The sanogenesis is inseparable from the pathogenesis
- Every sign of the disease is pathogenic and sanogenic in origin

Course of disease



- The natural history of the disease
- It refers to its development in a patient, including the sequence and speed of the stages and forms which they take

Typical courses of disease

- Chronic
- Recurrent or relapsing
- Subacute (between an acute and a chronic)
- Acute
- Fulminant or peracute (particularly acute, especially if unusually violent)



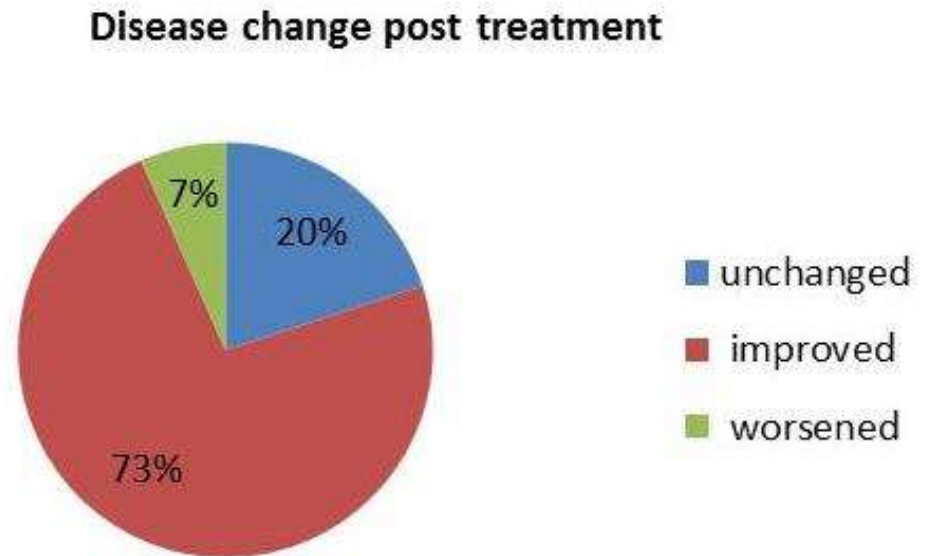
Compensation & decompensation in disease

	Compensated Cirrhosis		Decompensated Cirrhosis	
Stage	Stage 1	Stage 2	Stage 3	Stage 4
Clinical	No Varices No Ascites	Varices No Ascites	Ascites +/- Varices	Bleeding +/- Ascites
Death (at 1 Year)	1%	3%	20%	57%

- Phases of disease: compensation, subcompensation, decompensation
 - Compensation - adaptive processes fully reimburse broken or lost functions
 - Subcompensation - adaptive processes partially reimburse broken or lost functions
 - Decompensation - compensation is exhausted
- Forms of compensation
 - short-term
 - long-term

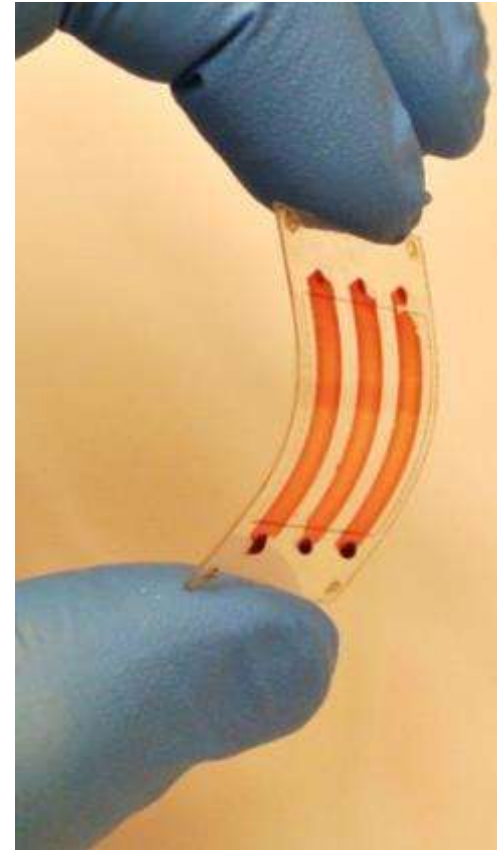
Outcomes of disease

- Recovery, relief, lack of improvement, deterioration, death
- Quality and degree of recovery are varied:
 - Complete recovery
 - Incomplete recovery
- Death is the most serious notion in clinic



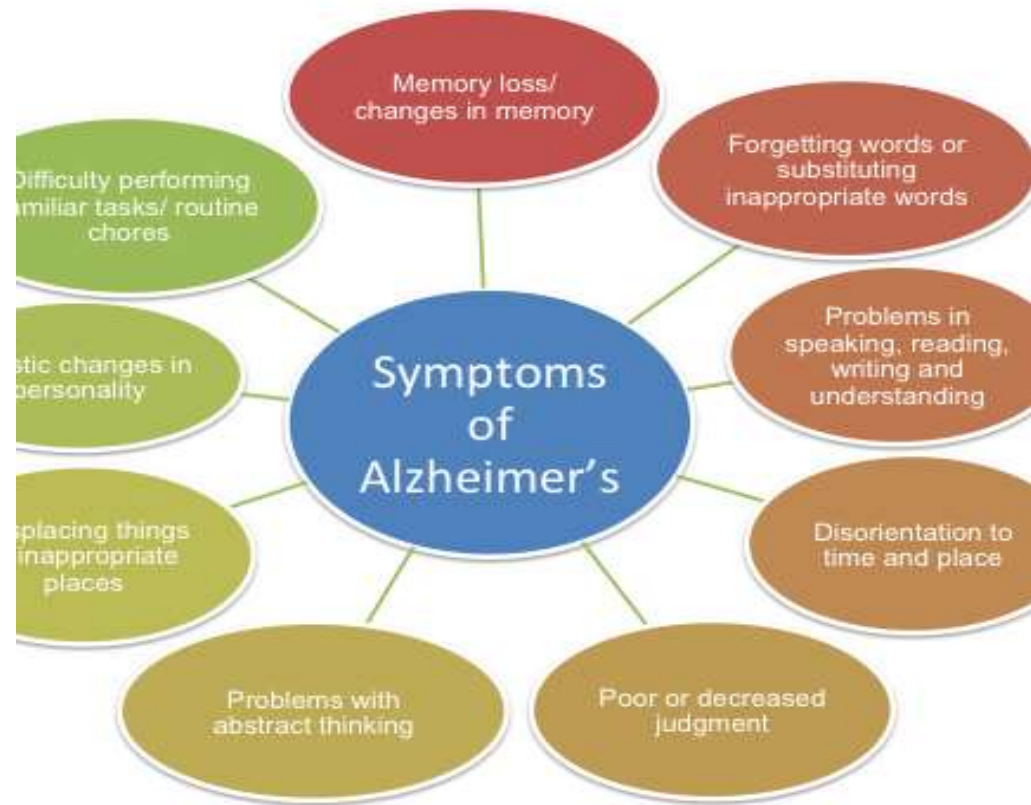
Diagnosis of disease

- Diagnosis is identification and labeling of a disease based on its signs and symptoms
- A diagnosis, in the sense of diagnostic procedure, can be regarded as an attempt of classification of an individual's condition into separate and distinct categories that allow medical decisions about treatment and prognosis to be made.
- A diagnostic procedure may be performed by various health care professionals such as a physician, a physical therapist, an optometrist, a healthcare scientist, a chiropractor, a dentist, a podiatrist, a nurse practitioner, or a physician assistant



Symptoms & signs of disease

- A symptom is generally subjective while a sign is objective
- Stomachache, lower-back pain, fatigue, etc. can only be detected or sensed by the patient and they are symptoms
- Any objective evidence of a disease, such as blood in the stool, a skin rash, is a sign – although some of them can be recognized by the patient or family members but in such case it must be confirmed by the doctor, nurse to be considered as objective sign
- Both symptom and sign are deviations from patient's normal state or feeling, reflecting the presence of an unusual state, or of a disease



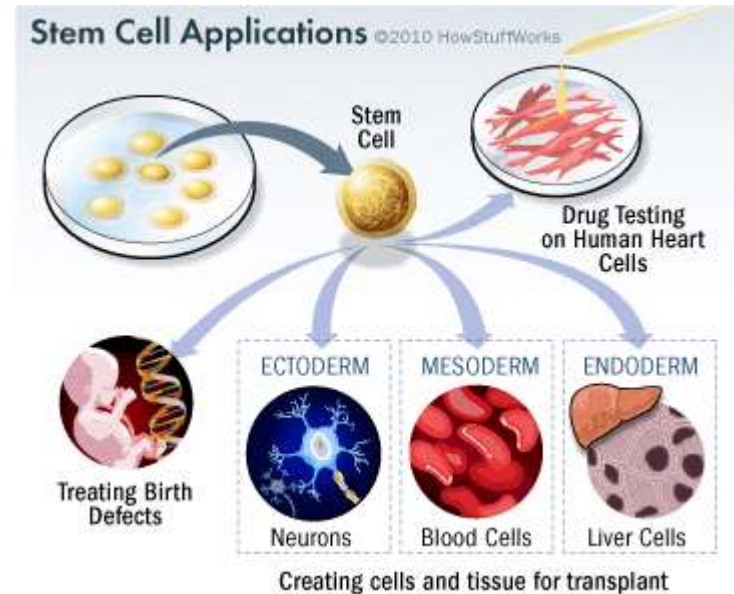
Prognosis of disease

- A prediction of the probable course and outcome of a disease
- A complete prognosis includes expected duration, a function, and a description of the course of the disease, such as progressive decline, intermittent crisis, or sudden, unpredictable crisis
- Prognosis:
 - for life
 - for recovery
 - for work capacity (disability)



Treatment of disease

- The use of an agent, procedure, or regimen, such as a drug, surgery, or exercise, in an attempt to cure or mitigate a disease, condition, or injury



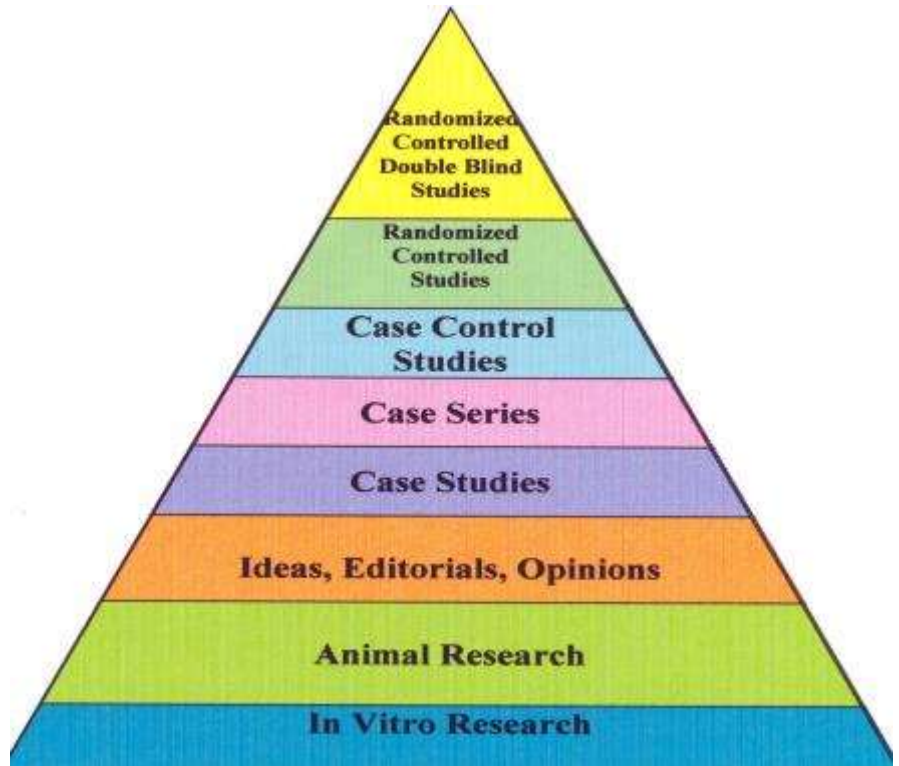
Prevention of disease

- Activities designed to protect patients or other members of the public from actual or potential health threats and their harmful consequences
- Disease prevention covers measures not only to prevent the occurrence of disease, but also to arrest its progress and reduce its consequences once established
- Primary prevention is directed towards preventing the initial occurrence of a disorder. Acts on the Prepathogenesis (Risk Factors)
- Secondary prevention acts on Pathogenesis. Includes early diagnosis , prompt treatment and prevention of associated disability
- Tertiary prevention acts on Resolution stage of the disease. Includes rehabilitation, reducing degree of disability/damage from crisis and reducing risk of future crisis



Evidence based medicine

Evidence-based medicine is conscientious explicit and judicious use of current best evidence in making decisions about the care of individual patients



Quality of life

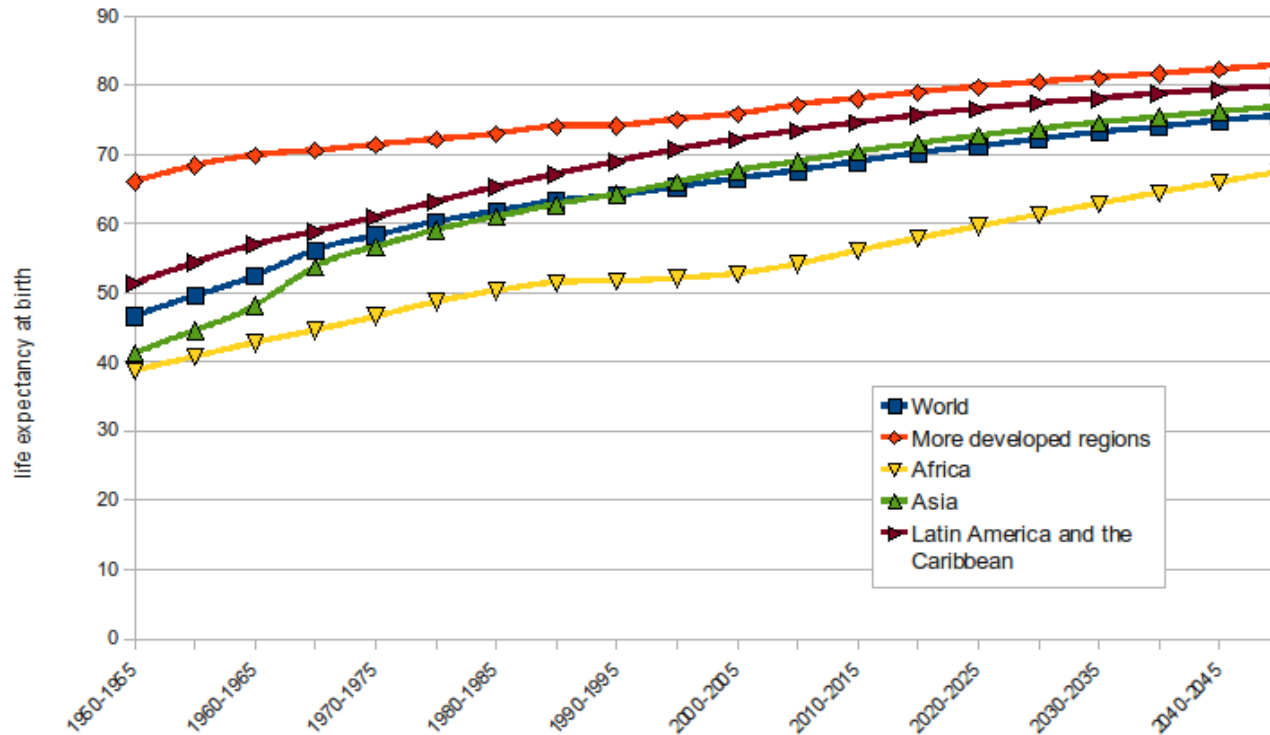
- Quality of life (QoL) is a ubiquitous concept that has different philosophical, political and health-related definitions
- Health-related QoL (HRQoL) includes the physical, functional, social and emotional well-being of an individual
- HRQoL is a patient-reported outcome usually measured with carefully designed and validated instruments such as questionnaires or semi-structured interview schedules
- These assessments are increasingly important when evaluating the benefits and harms of new treatments being tested in clinical trials
- They can also be used via touch screen technology to help monitor the impact of disease and its treatment on individual patients in the clinic.



Life expectancy

Life Expectancy at Birth by Region, 1950-2050.

Source: UN World Population Prospects, 2008.



The probable number of years remaining in the life of an individual or class of persons determined statistically, affected by such factors as heredity, physical condition, nutrition, and occupation.

Medical ethics

- Medical ethics is a system of moral principles that apply values and judgments to the practice of medicine
- As a scholarly discipline, medical ethics encompasses its practical application in clinical settings as well as work on its history, philosophy, and sociology



Principles of medical ethics

- I. A physician will be dedicated to providing competent medical care, with compassion and respect for human dignity and rights
- II. A physician will uphold the standards of professionalism, be honest in all professional interactions, and strive to report physicians deficient in character or competence, or engaging in fraud or deception, to appropriate entities
- III. A physician will respect the law and also recognize a responsibility to seek changes in those requirements which are contrary to the best interests of the patient
- IV. A physician will respect the rights of patients, colleagues, and other health professionals, and shall safeguard patient confidences and privacy within the constraints of the law
- V. A physician will continue to study, apply, and advance scientific knowledge, maintain a commitment to medical education, make relevant information available to patients, colleagues, and the public, obtain consultation, and use the talents of other health professionals when indicated.
- VI. A physician will, in the provision of appropriate patient care, except in emergencies, be free to choose whom to serve, with whom to associate, and the environment in which to provide medical care
- VII. A physician will recognize a responsibility to participate in activities contributing to the improvement of the community and the betterment of public health
- VIII. A physician will, while caring for a patient, regard responsibility to the patient as paramount
- IX. A physician will support access to medical care for all people

Medical deontology

- Medical deontology means professional ethics of medical workers and principles of behavior of medical personnel, directed toward maximum benefit of patient' treatment
- Medical deontology includes problems of observing medical confidentiality, the problem of the extent of the medical worker's responsibility for the life and health of the patient, and problems of relationships of medical workers to each other
- In accordance with medical deontology, in relation to the patient, the medical worker must evince maximum attention and apply all his knowledge in order to restore the patient to health or bring relief to him in his sufferings; he must convey to the patient only information about his health that will be beneficial to him and establish contact between the patient and the physician
- In the presence of a patient a physician must avoid conversations and discussions with colleagues, personnel, and with the patient himself concerning his illness, which sometimes produce the development of iatrogenic diseases

International Classification of Diseases (ICD)

- ICD is the standard diagnostic tool for epidemiology, health management and clinical purposes
- ICD includes the analysis of the general health situation of population groups
- ICD is used to monitor the incidence and prevalence of diseases and other health problems, providing a picture of the general health situation of countries and populations.
- ICD is used by physicians, nurses, other providers, researchers, health information managers and coders, health information technology workers, policy-makers, insurers and patient organizations to classify diseases and other health problems recorded on many types of health and vital records, including death certificates and health records
- Finally, ICD is used for reimbursement and resource allocation decision-making by countries
- All Member States use the ICD which has been translated into 43 languages
- Most countries (117) use the system to report mortality data, a primary indicator of health status
- ICD-10 was endorsed by the Forty-third World Health Assembly in May 1990 and came into use in WHO Member States as from 1994. ICD is currently under revision, through an ongoing Revision Process, and the release date for ICD-11 is 2017.

International Classification of Diseases (ICD) in Internal Medicine

- Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism (D50-D89)
- Endocrine, nutritional and metabolic diseases (E00-E90)
- Diseases of the circulatory system (I00-I99)
- Diseases of the respiratory system (J00-J99)
- Diseases of the digestive system (K00-K93)
- Diseases of the skin and subcutaneous tissue (L00-L99)
- Diseases of the genitourinary system (N00-N99)



Historic foundations of Internal Medicine

- Historically, some of the oldest traces of internal medicine can be traced from Ancient India and Ancient China. Earliest texts about internal medicine are Ayurvedic anthologies of Charka
- The terms "internal medicine, internal diseases" came from the XVIII-XIX centuries
- Hippocrates (Ancient Greece) gave the method of observation at the bedside, showed the importance of environmental and social factors in diseases, developed a personal approach to the patient
- Soranus of Ephesus (Ancient Rome) developed symptomatology of diseases
- Galen (Ancient Rome) laid the basis for healing on the grounds of achievements in ancient anatomy and physiology, built and developed the ideas of integrity of the structure and function in biology and medicine
- Ibn Sina (Ancient East) developed clinical semiotics
- Paracelsus (Switzerland) introduced the chemical drugs into treatment

The base of modern Internal Medicine

XVIII-XIX centuries: the base of modern medicine with three approaches that are integrated within a single entity:

- British doctors' approach – creation of general theory of disease, based on the ideas of balance of body fluids and development of the conception of disease as a violation of this balance
- French doctors' approach - development of modern physical examination techniques for recognition of the anatomic localization of disease in the living patient
- German doctors' approach - clinical observations were completed with experimental studies

On the way to modern Internal Medicine in Ukraine

- XIX century : establishment of internal medicine clinic
- one of the first medical schools in the Kharkiv University: LL Ghirshman, VF Grube, VY Danilevsky, IO Kalinichenko, IP Lazarevic, DF Giardia, IA Sviridov, NP Trinkler, AI Khodnev, PM Shymlanskaya were among the first teachers
- XX -XXI centuries in Ukraine: VA Bobrov, GI Burchinsky, VH Vasilenko, AV Vinogradov, MS At all, MM Gubergrits, NA Gvatua, AL Crest, AI Gritsyuk, AJ Gubergrits, NF Deyneko, VN Dzyak, G.V.Dzyak, AI Dyadyk, VF Zelenin, SS Zimnitsky, IA Kassirskii, VN Kovalenko, FI Komarov, MG Kurlov, Y. Linevsky, PE Lukomskii, LT Malaya, NS Molchanov, AL Myasnikov, NS Pilipchuk, DD Pletnev, L. Rozenshtrauh, ND Strazhesko, MI Frankfurt, EI Chazov, MV Chernorutskii, BS Shkliar, FG Janowski and others

Easy way to learn Internal Medicine

- In most institutions, Internal Medicine is organized as a Department of Internal Medicine
- Although the structure of Departments of Internal Medicine may vary, particularly in schools that have more than one teaching hospital, they typically are made up of multiple divisions, often based on different subspecialties of internal medicine
- In Medical School you only need to look around you to see internists and what they do
- If you are interested, this may be one of the best ways to learn about the breadth and depth of Internal Medicine!
- Learn Internal Medicine online every day too, for example with <https://www.youtube.com/watch?v=danNTelK7fw>

Lecture 2

Approach to the patient

Plan of the lecture

Approach to a patient

- Medical tests
- Interviewing of a patient
- Physical examination of a patient
- Instrumental methods for evaluating of a patient status
- Laboratory methods for evaluating of a patient status
- Examination of patients who lack decision-making capacity
- Cost-effectiveness of patients examination

Medical test: definition

A medical test is a kind of medical procedure performed to detect, diagnose, or monitor diseases, disease processes, susceptibility, and determine a course of treatment



Medical test: types

By purpose:

- Diagnostic (to confirm, or determine the presence of disease or to exclude disease in an individual suspected of having the disease)
- Screening (to detect or predict the presence of disease in individuals at risk for disease or to exclude disease/ risk factor)
- Monitoring (to monitor the progress or regress of disease, and response to medical treatment including side effects)

By method :

- interviewing (questions asked)
- physical examination
- laboratory /instrumental (radiologic, in vivo diagnostics, in vitro diagnostics etc.)

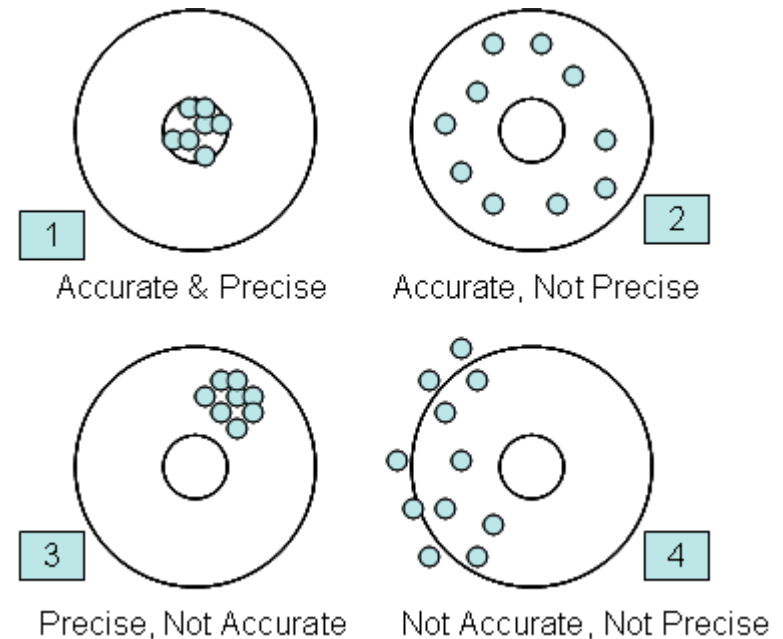
By sample location:

- blood
- urine
- sputum
- liquor, etc.



Medical test: accuracy and precision

- Accuracy of a test is its correspondence with the true value
- Accuracy is maximized by calibrating equipment with reference material and by participation in external quality control programs
- Precision is a measure of tests reproducibility when repeated on the same sample
- An imprecise test is one that yield widely varying results on repeated measurement
- The precision is monitored by using control material



Medical test: positive or negative

- The result of a test aimed to detect an entity may be positive or negative: this has nothing to do with a favorable or unfavorable prognosis, but rather means that the test worked or not, and a certain parameter that was evaluated was present or not (a negative screening test for breast cancer means that no sign of breast cancer could be found (which is in fact very positive for the patient))
- The classification of test results into either positive or negative gives a binary classification, with resultant ability to perform Bayesian probability and performance metrics of tests, including calculations of sensitivity and specificity



Medical tests: three categories

- Invasive (requiring the entry of a needle, catheter, or other instrument into a part of the body)
- Minimally invasive (is carried out by entering the body through the skin or through a body cavity or anatomical opening, but with the smallest damage possible to these structures - minimally invasive endoscopy)
- Non-invasive \neq safe (X-Ray - exposure to radiation, with caution in pregnancy)



Interviewing of a patient: nature and goals

- A patient's interviewing may have greater diagnostic value than either the physical or the laboratory investigations
- More than 2/3 of diagnoses can be made on the basis of a patient's interviewing alone
- An accurate interviewing also provides focus to the physical and the laboratory examination, making them more efficient
- Clinical hypotheses generated during an interview provide basis for a cost-effective utilization of the physical, laboratory and other diagnostic modalities
- A patient enters an interview seeking relief from the discomforts and uncertainties of illness, while a physician actively conducts the interview in order to clarify his (her) problems and derive favor diagnostic and therapeutic plans
- The interview becomes a dialogue between two (in most cases) persons driven toward a common goal

Interviewing of the patient: two couples basic approaches

First couple basic approach :

- The problem-oriented interview reflects the patient's request for help with specific problems
- The health promotion interview establishes a data baseline concerning the patient's current , past and future health problems

Second couple basic approach

- Diagnostic tasks
- Therapeutic tasks



In reality, doctors combine both couples basic types of the patient interviewing

Interviewing of the patient: three golden rules

1. Avoid "closed-ended-questions", that can be answered with a "yes" or a "no"
2. Use the patient's words, and only the patient's words
3. If a patient denies complaints involving a specific area/function, require him to confirm that there is nothing wrong with it



Interviewing of the patient: characterizing the symptoms

Every symptom can be characterized by 7 sets of bodily and emotional aspects

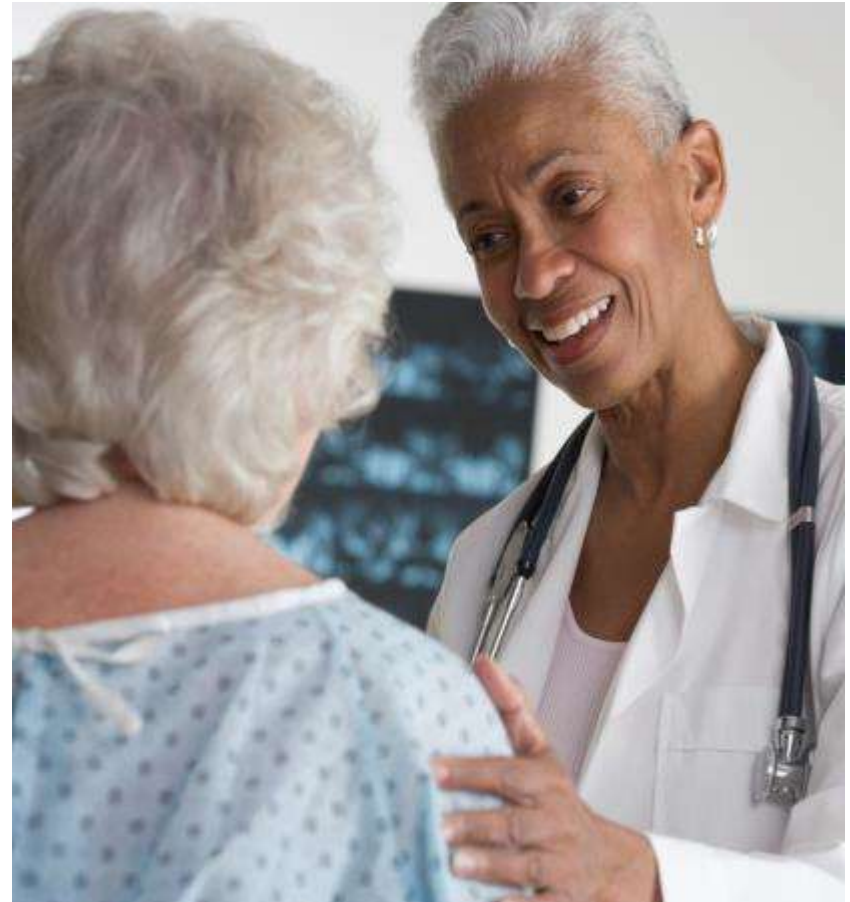
- Chronology
- Bodily location
- Quality
- Quantity
- Setting
- Any aggravating or alleviating factors
- Associated manifestations



Interviewing of the patient: the chief complaint

- The chief complaint means the primary symptom that a patient states as the reason for seeking medical care
- It is necessary ranks the symptoms in order of importance and listens for patterns that suggest disease processes
- Some symptoms will be clearly related to the chief complaint , others are unrelated or of only possible relevance

Patient may talk about embarrassing or confidential problems when rapport and trust have been deepened and occasionally bring up important issues only at the end of the encounter



Interviewing of the patient: the history of the present illness

- The history of the present illness (HPI) includes all of the patient's history, both recent and remote, that is pertinent to understanding the current illness
- It is recommend to scan the information already gathered looking for symptom complexes or diagnostic patterns
- With increasing understanding of clinical symptom complexes and diagnostic patterns ability to form more complex diagnostic hypotheses grows
- Each hypothesis is tested for validity with further specific questions



Interviewing of the patient: drug history

- Drugs used
- Dose
- Dosing schedule
- Prescriber
- Reason for prescribing the drugs
- Precise nature of any drug allergy
- Tolerance (side effects)
- Compliance to treatment



Interviewing of the patient: past history

Three key parts:

- Past Medical History (a review of past medical problems and treatments not directly pertinent to the HPI completes the past medical history) includes childhood and adult illnesses, surgery interventions, trauma, allergies and drug sensitivities (characterized in detail), obstetric/gynecologic problems in females, immunizations, and health maintenance
- Family History (medical problems in relatives ≈ hereditary issues)
- Social history/Patient profile (the patient's education, occupation, marital status, usual daily activities, functional status, relationships with friends and family, social supports and stresses, financial status/insurance coverage and habits such as smoking or alcohol consumption that have known negative health consequences)



Interviewing of the patient: review of systems

- Before concluding the interview it is necessary to make review of systems (R.O.S.) to assure that all areas of the patient's health have been considered
- The entire R.O.S. should take less than 5 minutes



Interviewing of the patient: the SAMPLE helpful mnemonic system

Signs/Symptoms reported by the patient

Allergies

Medications

Past Medical History

Last Oral Intake

Events leading to this episode of Injury or illness



This system help us to avoid missing important patient assessment steps and questions

Interviewing of the patient: three categories of problems

1. Problems with the patient (e.g., intense emotional reactions, altered mental status, unrealistic fantasies about the doctor)
2. Problems with the interviewer (e.g., an overly judgmental attitude, too directive approach in questioning, failure to listen to the patient)
3. Problems with the physician–patient relationship (e.g., a language barrier, failure to negotiate a shared goal for the encounter)



Interviewing Milestones

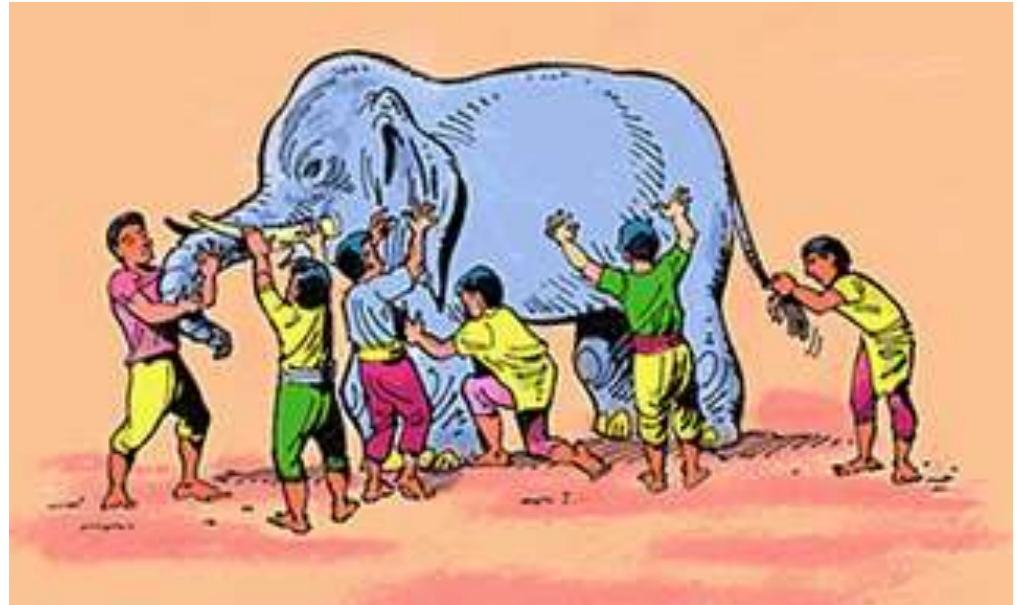
- Getting Ready. The approach to the interview taking time for self-reflection. Reviewing the chart. Reviewing your clinical behavior and appearance. Adjusting the environment. Taking notes
- Learning About the Patient. The Sequence of the interview greeting the patient and establishing rapport. Inviting the patient's story. Setting the agenda for the interview. Expanding and clarifying the patient's story. Creating a shared understanding of the patient's concerns. Negotiating a plan. Following up and closing the interview
- Building the Relationship. The techniques of skilled interviewing active listening. Guided questioning. Nonverbal communication. Empathic responses. Validation. Reassurance. Partnering. Summarization. Transitions. Empowering the patient
- Adapting interview to specific situations. The silent patient. The confusing patient. The patient with impaired capacity. The talkative patient. The angry or disruptive patient. Interviewing across a language barrier. The patient with low literacy. The deaf or hard-of-hearing patient. The blind patient. The patient with limited intelligence. The patient seeking personal advice
- Sensitive topics that call for special skills/ The sexual history. Mental health. Alcohol and drug use. Family violence. Death and dying
- Societal Aspects of Interviewing Achieving cultural competence. Sexuality in the clinician–patient relationship. Ethical considerations

Physical examination of the patient: definition

Physical examination is the process of evaluating objective anatomic and functional findings through the use of observation, palpation, percussion, and auscultation

The information obtained must be thoughtfully integrated with the patient's history

The physical examination, thoughtfully performed, should yield 20% of the data necessary for patient diagnosis and management

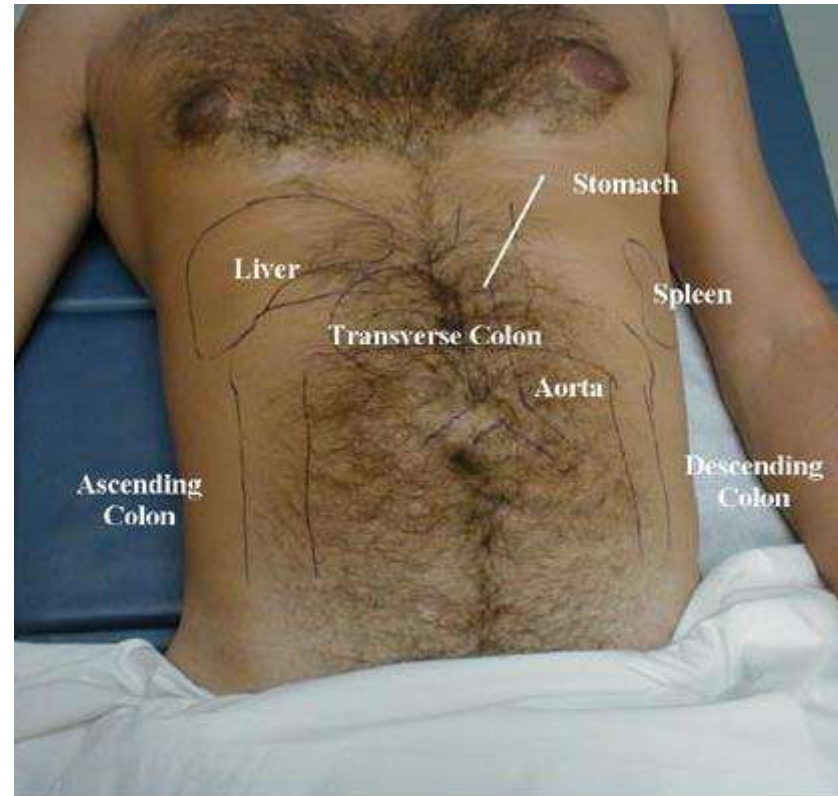


Physical examination of the patient: requirements

- The observer should examine the patient in privacy, preserving the patient's modesty before and after the physical examination
- The observer should not assist a patient to dress or undress unless the patient is having difficulty and requests assistance
- The observer should avoid making inappropriate verbal or non-verbal expressions during the examination
- The observer should ensure the examination is not interrupted by phone calls or other unnecessary interference
- Following an examination or investigation, the findings should be communicated to the patient
- Intimate examinations such as examination of the genitals, breasts, or internal examinations can cause particular distress; gloves should always be worn when conducting an intimate or internal examination
- Observers should be aware that patients have their own views regarding what constitutes an intimate examination

Physical examination of the patient: types

- Routine physicals are performed on asymptomatic patients for medical screening purposes
- Comprehensive (executive) physicals typically supports by laboratory tests, chest x-rays, pulmonary function testing, audiograms, full body CAT scanning, EKGs, heart stress tests, vascular age tests, urinalysis, and mammograms or prostate exams depending on gender
- Pre-employment examinations (clearance) are screening tests which judge the suitability of a worker for hire based on the results of their physical examination
- Insurance exams are performed as a condition of buying health insurance or life insurance



Physical examination of the patient: context

Some medical history about the patient is available at the time of the physical examination

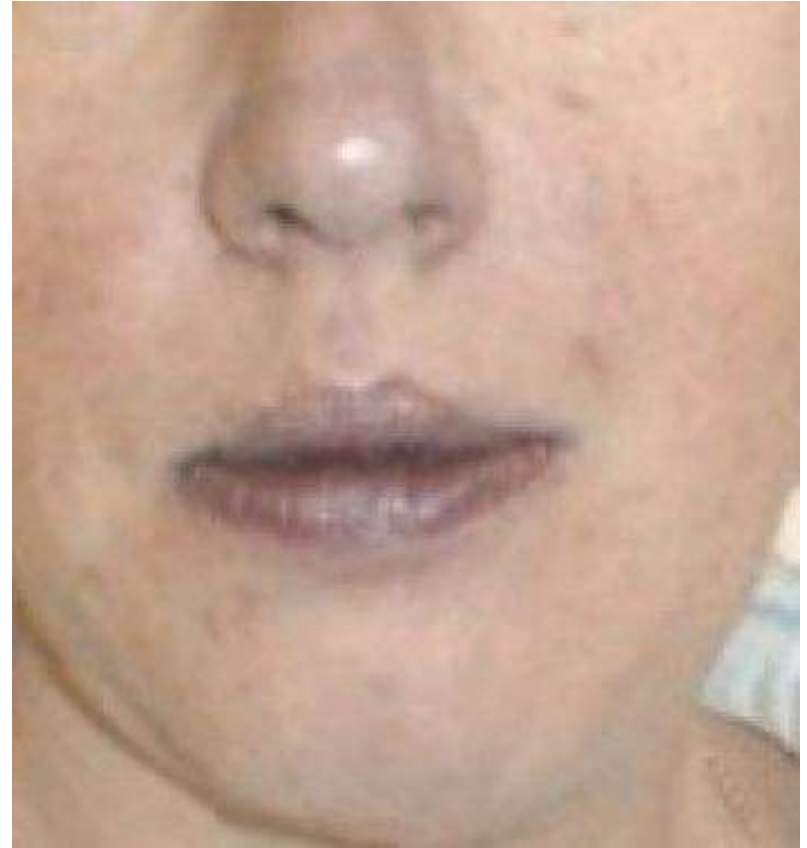
Information pertinent to the physical examination can be learned from observation of speech, gestures, habits, gait, and manipulation of features and extremities

Interactions with relatives and staff are often revealing

Skin color changes such as cyanosis, jaundice, and pallor may be noted

Sweating, blanching, and flushing may provide clues about vasomotor tone related to mood or physiologic abnormalities

Aspects of patient habits, interests, and relationships can be ascertained from pictures, books, magazines, and personal objects at the bedside



Physical examination of the patient: physician–patient interaction

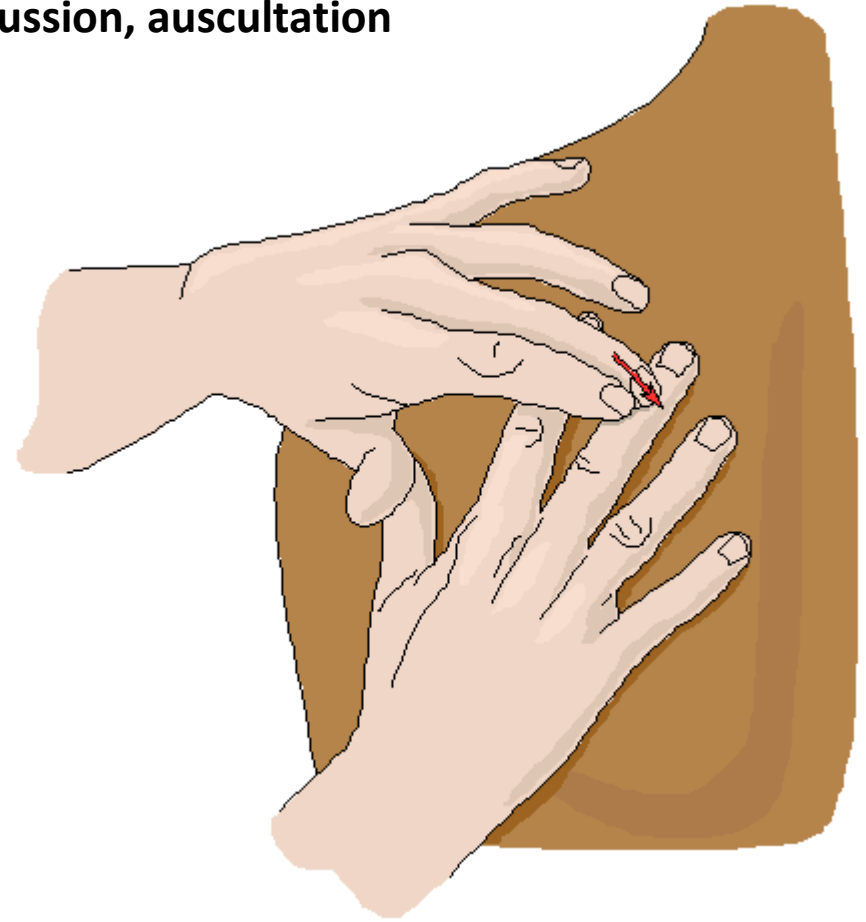
- Aside from the office, physical examination may occur in a variety of settings where it is difficult to establish privacy and quiet
- The patient should be addressed politely and asked to perform the required maneuvers of the examination
- Patients should be prepared for unpleasant portions of the examination
- An examination that ends abruptly may diminish the value of the doctor–patient relationship and may destroy its therapeutic content
- The patient may benefit from a brief summary of relevant findings and may require reassurance about what has and has not been found



Physical examination of the patient: four parts

Each organ system ought to be examined in the same order: I. P. P. A.
– inspection, palpation, percussion, auscultation

- Inspection: looking for signs
- Palpation: feeling for signs
- Percussion: tapping for signs, used when doing a lung and/or gut examination.
- Auscultation: listening using the stethoscope, or in olden times, purely listening with direct ear.



Physical examination of the patient: the tools required for the examination

- Cotton wisp
- Flashlight
- Lubricating jelly
- Mydriatic solution
- Oto-ophthalmoscope
- Paper towels
- Rectal gloves
- Reflex hammer
- Sphygmomanometer
- Stethoscope
- Tape measure
- Thermometer
- Tissues
- Tongue depressors
- Tuning fork (128 Hz)
- Vials of coffee and cinnamon

Physical examination of the patient: main points

- As the environment affects the quality of the physical examination, it is wise to arrange for quiet and privacy, darkening the room for parts of the examination, and comfort for the patient and observer
- The complete examination should proceed in an orderly fashion with a minimum of required position shifts by the patient
- The observer must be able to ascertain the integrity of the various organ systems from regional examinations
- When examining an anatomic region, the observer must be alert to the appearance of any abnormality and question at the time the morphologic aspects of the abnormality and its clinical significance

Physical examination of the patient: positions of patient and observer

Anatomical area or activity	Patient	Observer
Vital signs, general inspection	Sitting or reclining	Standing before patient or at bedside
Head and neck	Sitting	Standing before patient
Anterior torso	Sitting	Standing before patient initially, later behind the patient
Posterior torso	Sitting	At patient's side
Anterior chest and abdomen	Supine	Before the patient
Male genitalia	Standing	Before the patient
Gait, station, coordination	Variable positions	Behind the patient
Female genitalia	Reclining on examining table, draped, knees flexed, legs adducted, feet in stirrups	Sitting on stool at times or standing

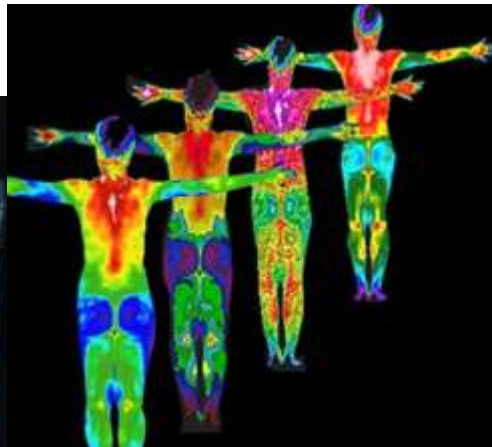
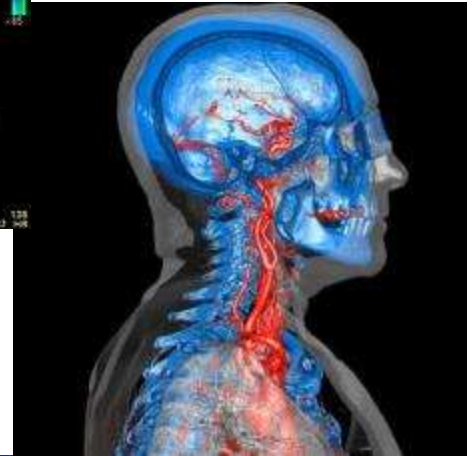
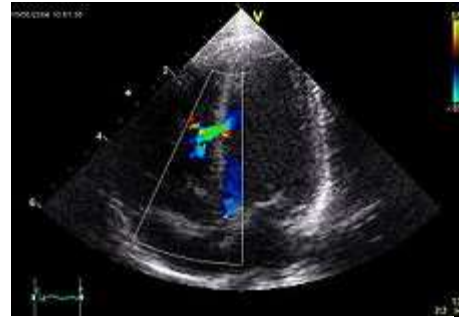
Physical examination of the patient: vital signs

- Weight
- Height
- Temperature
- Pulses
- Blood Pressure
- Respiratory rate



Instrumental methods for evaluating of the patient status: visualization

- X-ray
- Computer tomography
- Echo
- Endoscopy
- Infrared thermography
- MRI

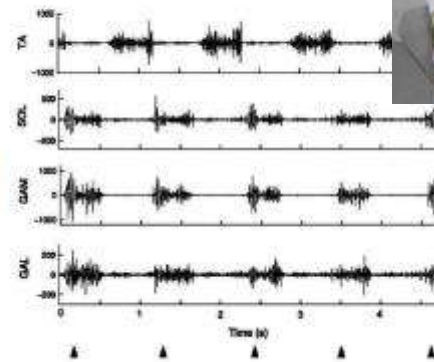
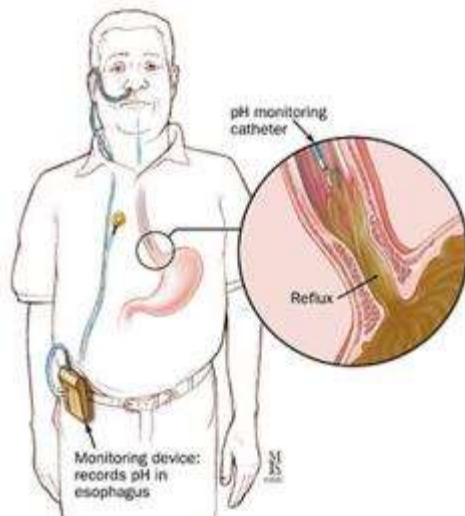
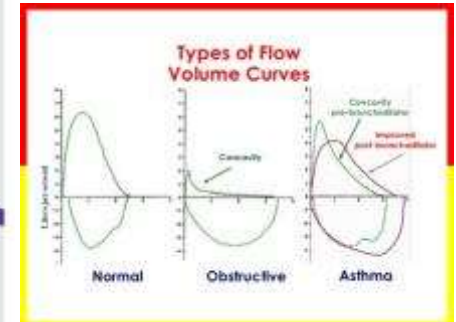
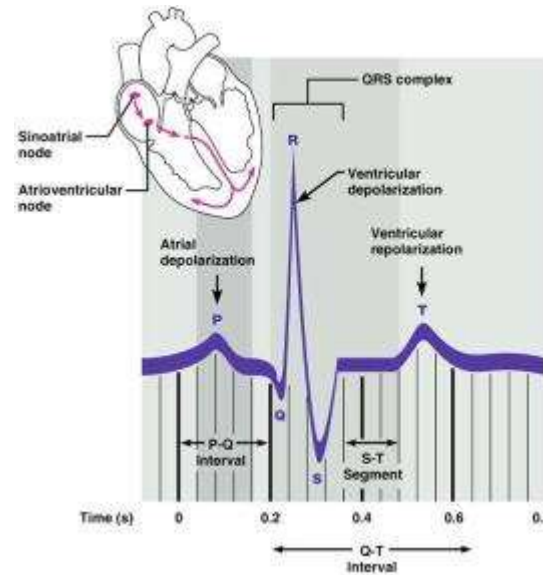


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Instrumental methods for evaluating of the patient status: physiological processes

- Electrocardiography
- Spirometry
- Electromyography
- Ph-metry



Instrumental methods for evaluating of the patient status: cardiac stress testing

Type of stress

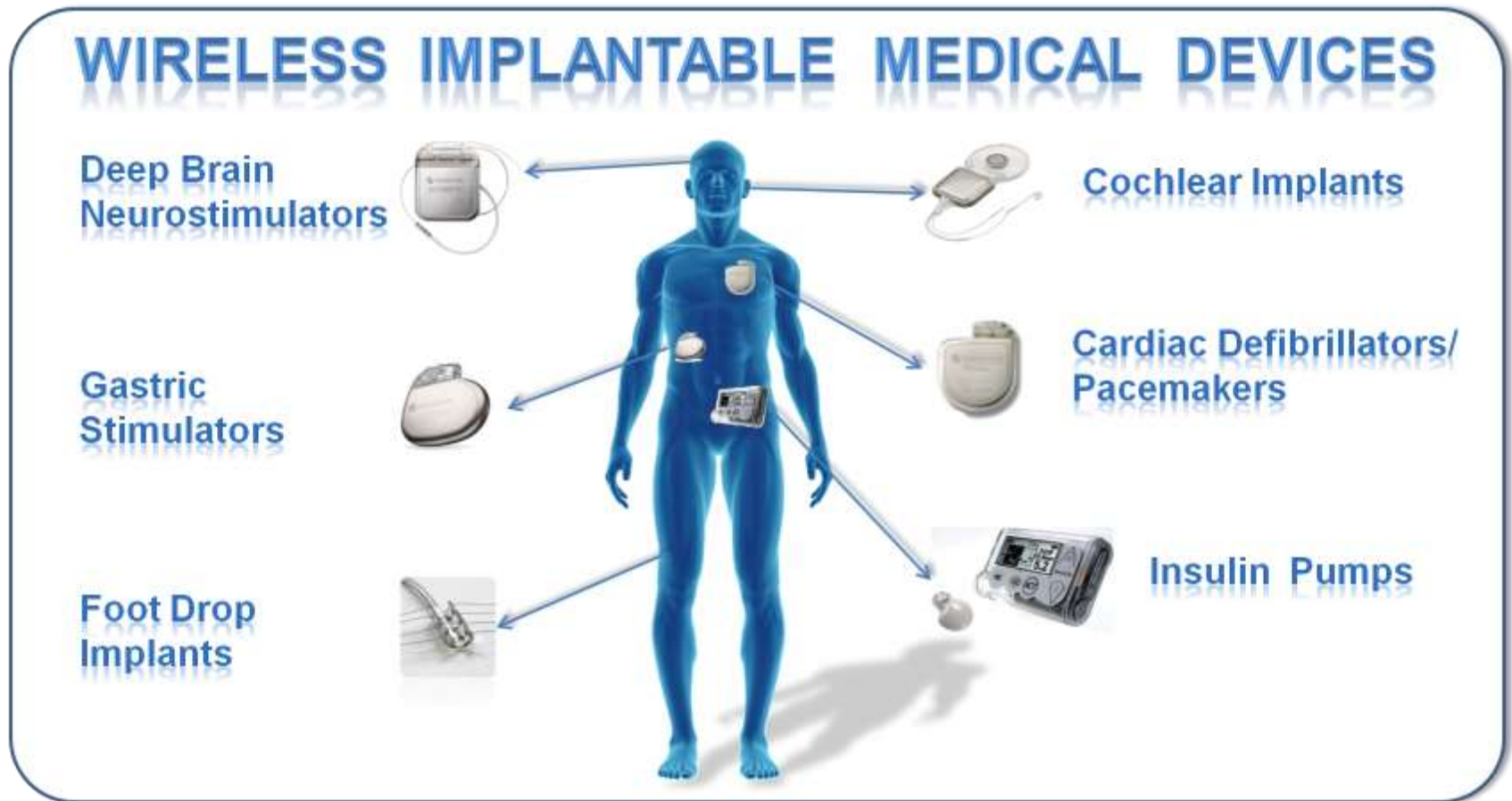
- Exercise stress tests(treadmill or ergometer)
- Pharmacological tests (simulating exercise for patients unable to exercise on a treadmill/ ergometer)

Type of investigation

- Electrocardiography
- Echocardiography
- Nuclear imaging



Instrumental methods for evaluating of the patient status: implantable devices



Laboratory methods for evaluating of the patient status: complete blood count

Type of Cell	Increase	Decrease
<u>Red Blood Cells</u> (RBC)	<u>erythrocytosis</u> or <u>polycythemia</u>	<u>anemia</u> or <u>erythroblastopenia</u>
<u>White Blood Cells</u> (WBC):	<u>leukocytosis</u>	<u>leukopenia</u>
– <u>lymphocytes</u>	– <u>lymphocytosis</u>	– <u>lymphocytopenia</u>
– <u>granulocytes</u> :	– <u>granulocytosis</u>	– <u>granulocytopenia</u> or <u>agranulocytosis</u>
– <u>neutrophils</u>	– <u>neutrophilia</u>	– <u>neutropenia</u>
– <u>eosinophils</u>	– <u>eosinophilia</u>	– <u>eosinopenia</u>
– <u>basophils</u>	– <u>basophilia</u>	– <u>basopenia</u>
<u>Platelets</u>	<u>thrombocytosis</u>	<u>thrombocytopenia</u>
All cell lines	–	<u>pancytopenia</u>

Laboratory methods for evaluating of the patient status: comprehensive metabolic panel

Specimen	Normal Range	Units
Albumin	3.9 - 5.0	g/dL
Alkaline phosphatase	44 - 147	IU/L
ALT (alanine aminotransferase)	8 - 37	IU/L
AST (aspartate aminotransferase)	10 - 34	IU/L
BUN (blood urea nitrogen)	7 - 20	mg/dL
Calcium	8.5 - 10.9	mg/dL
Chloride	96 - 106	mmol/L
CO2 (carbon dioxide)	20 - 29	mmol/L
Creatinine	0.6 - 1.1 (women) 0.7 - 1.3 (men)	mg/dL
Glucose	70 - 100	mg/dL
Potassium	3.7 - 5.2	mEq/L
Sodium	136 - 144	mEq/L
Total bilirubin	0.2 - 1.9	mg/dL
Total protein	6.3 - 7.9	g/dL

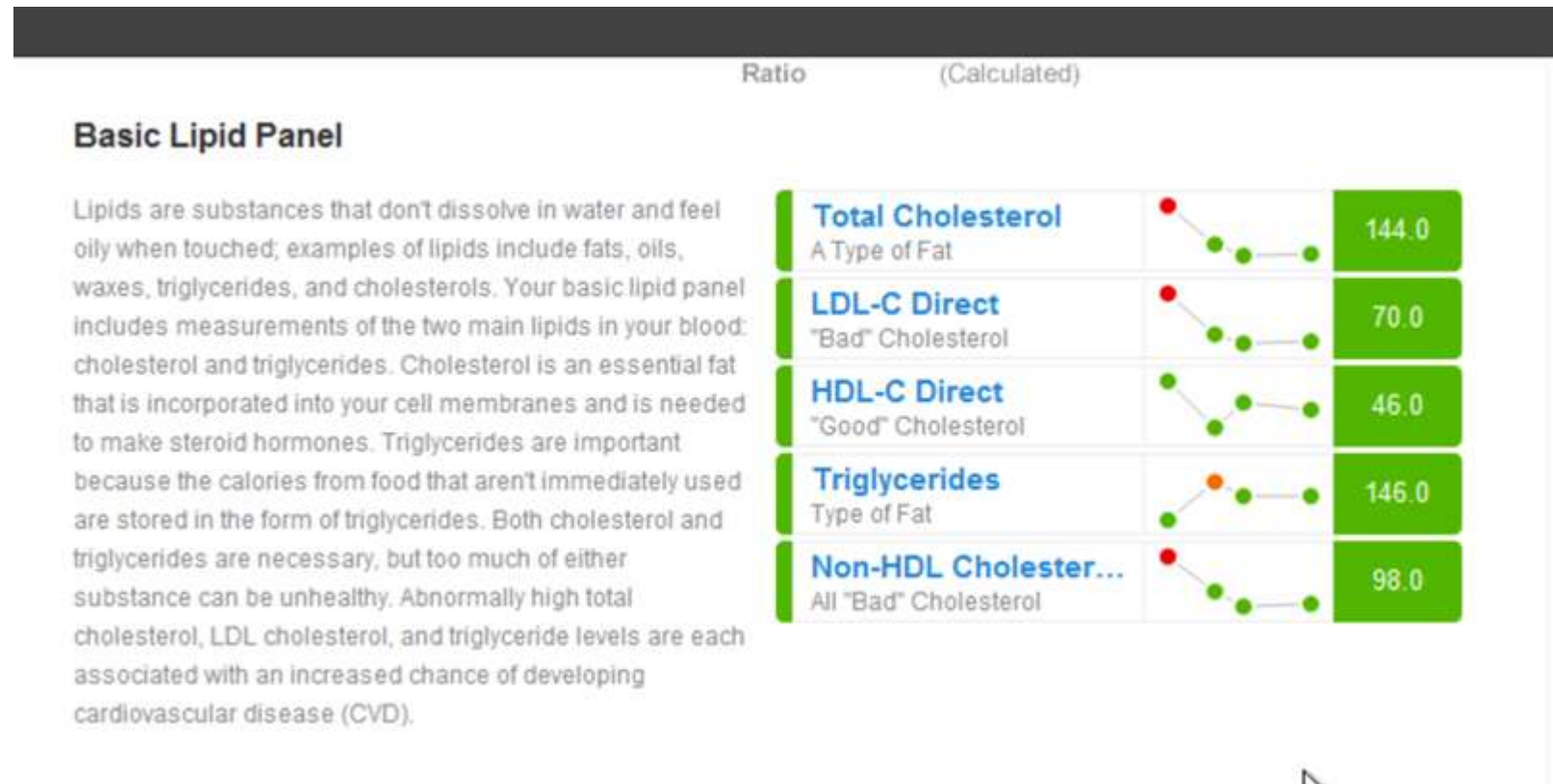
Laboratory methods for evaluating of the patient status: hepatic function tests

Specimen	Normal Range ^[3]	Units
Aspartate aminotransferase (AST)	0-42	U/L
Alanine aminotransferase (ALT)	♥ 0-20; ♠ 0-35	U/L
Alkaline phosphatase (ALP)	♥ 39-118; IU/L ♠ 41-137 IU/L; ♦ 95-368	U/L
Bilirubin	0-1.2	mg/dL
Blood Urea Nitrogen (BUN)	10-20 mg/dL; ♦ 5-18 mg/dL; ♦ 3-12	mg/dL
Creatine (Cr)	♥ 0.6-1.2 mg/dL; ♠ 0.7-1.3 mg/dL; ♦ 0.2-1.0	mg/dL
BUN to Creatine Ratio (BUN: Cr)	varies	
Uric Acid	3.5 and 7.2	mg/dL
Ammonia	15 – 45	mcg/dL

Laboratory methods for evaluating of the patient status: cardiac markers

Specimen	Normal Range ^[3]	Units
Troponin T	< 0.1	ng/mL
Troponin I	< 0.03	ng/mL
Total CK Creatine kinase (CK-T)	30-135, 55-170	IU/L
Creatine kinase-MB (CK-MB)	5	ng/mL
β-type natriuretic peptide (BNP)	0.5-30	pg/mL

Laboratory methods for evaluating of the patient status: lipid panel



Laboratory methods for evaluating of the patient status: coagulation studies

Specimen	Normal Range	Units
Prothrombin Time (PT)	10-13	seconds (for blood sample to coagulate)
International Normalized Ratio (INR)	2.0-3.0	(patients on warfarin therapy)
Partial Thromboplastin Time (PTT or aPTT)	20-36	seconds

Laboratory methods for evaluating of the patient status: thyroid hormones

Specimen	Normal Range	Units
Thyroid Stimulating Hormone (TSH)	0.4 – 4.0	mIU/L (milli-international units per liter)
Triiodothyronine (T3)	2.3- 4.2	pg/mL
Thyroxine (T ₄)	0.8 – 1.8	ng/L
Anti-thyroid peroxidase antibodies (TPO-Ab)	Anti-thyroid antibodies are evaluated through the use of a highly sensitive radioimmunoassay system (Wakita, Nagasaki, Nagata, Imanishi, Yamada, Yoda, Emoto, Ishimura, & Inaba)	
Anti-thyroglobulin antibodies (Tg-Ab)		

Laboratory methods for evaluating of the patient status: pH, arterial blood gases, oxygen

Specimen	Normal Range	Units
pH	7.34-7.44	
H ⁺	35–45	nmol/L(nM)
Arterial oxygen partial pressure (P _a O ₂)	11-13	kPa
Arterial carbon dioxide partial pressure (P _a CO ₂)	4.7-6.0	kPa
HCO ₃ ⁻	22–26	mEq/L
SBC _e	21 to 27	mmol/L
Base excess	-2 to +2	mmol/L
<i>total</i> CO ₂ (tCO ₂ (P) _c)	23-30	mmol/L
O ₂ Content (C _a O ₂ , C _v O ₂ , C _c O ₂)	Vol	% (mL oxygen/dL blood)

Laboratory methods for evaluating of the patient status: immune system and inflammatory markers

Specimen	Normal Range	Units
Erythrocyte Sedimentation Rate (ESR)	3 - 13	mm/hr
C-Reactive Protein (CRP)	> 3.0 = high risk for cardiovascular disease	mg/L
Antinuclear Antibody Panel (ANA)	The panel is obtained to detect signs of certain conditions such as autoimmune disease	

Laboratory methods for evaluating of the patient status: urine studies

Specimen	Normal Range	Units
Specific Gravity of Urine	1.005-1030	mm/hr
Urine Osmolality	300-900	mOsm/kg/24 hours
Creatinine Clearance	♥ 84, ♠ 90	mg/min/173 m ² of body surface
Urine Sodium Concentrate	10-20	mEq/L
Urine Output	1,000-2,000	mL/day

Laboratory methods for evaluating of the patient status: microbiologic examination

Test	Clinical Significance
Urine Culture	To diagnose a urinary tract infection
AFB Culture	To help identify a mycobacterial infection, to diagnose tuberculosis, to monitor the effectiveness of treatment
Herpes Culture	To screen for or diagnose infection with the herpes simplex
Rapid Beta Screen	To determine if a sore throat (pharyngitis) is caused by a Group A streptococcal bacteria ("strep throat")
Chlamydia Screen	To screen for or diagnose chlamydia infection
GC Screen	To screen for Neisseria gonorrhoeae, which causes the sexually transmitted disease gonorrhea
MRSA Screen	To identify the presence of S. aureus, to determine whether it is a MRSA strain, and to evaluate the staph's susceptibility to available antibiotics
VRE Screen	VRE are specific types of antimicrobial-resistant staph bacteria

Laboratory methods for evaluating of the patient status: fecal analysis

Test	Clinical Significance	Normal Range
Blood	To screen for gastrointestinal bleeding, which may be an indicator of colon cancer	Negative
C Difficile Toxin	To detect the presence of Clostridium difficile toxin	Negative
Giardia Specific Antigen	To detect protein structures on the giardia parasite	Negative
White Blood Cells (WBC'S)	WBC may be present in the stool when there is a bacterial infection	None Seen

Examination of patients who lack decision-making capacity

- Patients who lack decision-making capacity (such as children) require a surrogate decision-maker to consent to the examination. A familiar individual such as a family member or caregiver should generally accompany an individual during the examination



Cost-effectiveness of patients examination

- Cost-effectiveness analysis compares the costs and health effects of an intervention to assess the extent to which it can be regarded as providing value for money
- It is necessary to distinguish between independent interventions and mutually exclusive interventions
- For independent interventions, average cost-effectiveness ratios suffice, but for mutually exclusive interventions, it is essential to use incremental cost-effectiveness ratios if the objective – to maximize healthcare effects given the resources available – is to be achieved
- Cost-effectiveness ratios should be related to the size of relevant budgets to determine the most cost-effective strategies



Lecture 3

Approach to the patient with disease
of the respiratory system

Plan of the lecture

Approach to the Patient with Disease of the Respiratory System

- Interviewing of the patient
- Physical examination of the patient
- Instrumental methods for evaluating of the patient status
- laboratory methods for evaluating of the patient status

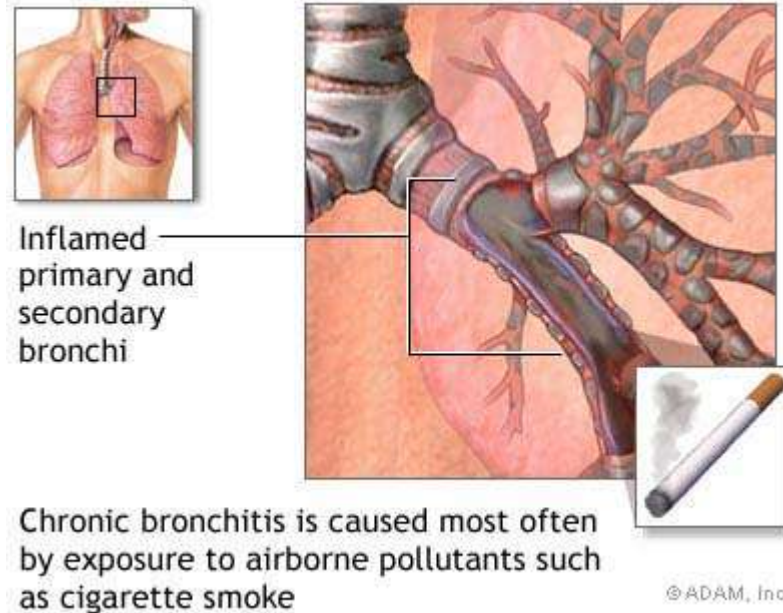
Interviewing of the patient: the chief symptoms

- Dyspnoea: orthopnea, paroxysmal nocturnal dyspnea (PND), severity
- Cough: time of day, severity, type (dry, moist, wet, productive, hoarse, hacking, barking, whooping), onset, duration, wheezing, associated symptoms
- Sputum: quantity, color, consistency, time of day, odor, pattern of production
- Hemoptysis: source, color, quantity
- Chest pain
- Wheezing



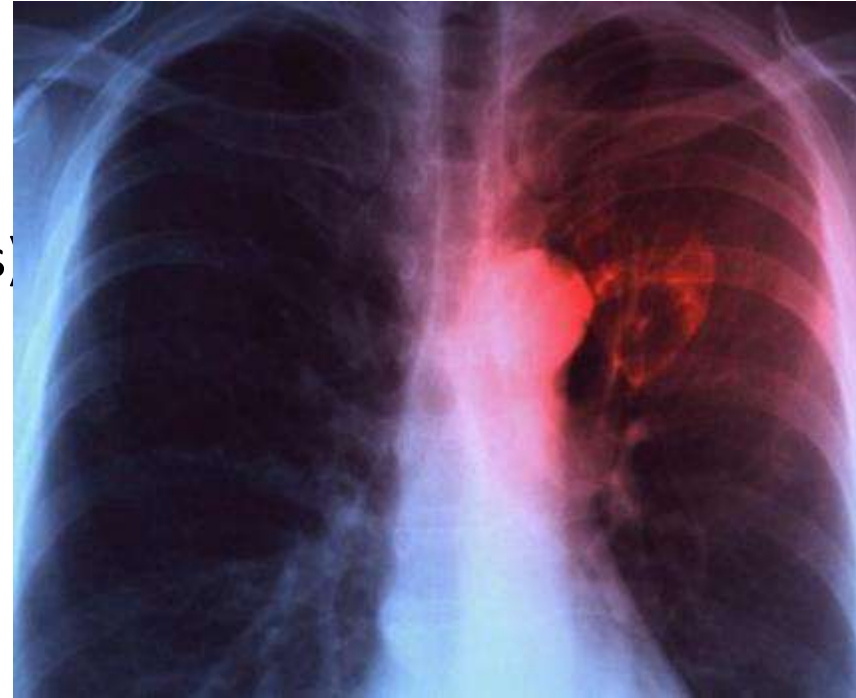
Interviewing of the patient: the general symptoms

- Fever
- Weight loss
- Oedema
- Night sweats
- Nocturia
- Daytime somnolence



Interviewing of the patient: other systems

- Loss of appetite (a common feature whenever people are unwell)
- Significant loss of weight (serious illness, e.g. malignancy or tuberculosis)
- Upper gastrointestinal symptoms as common cause of chronic cough
- Heart disease (may cause respiratory symptoms)
- Severe anaemia (may cause breathlessness)
- Rheumatoid arthritis and other connective tissue diseases
- Neuromuscular diseases



Tuberculosis

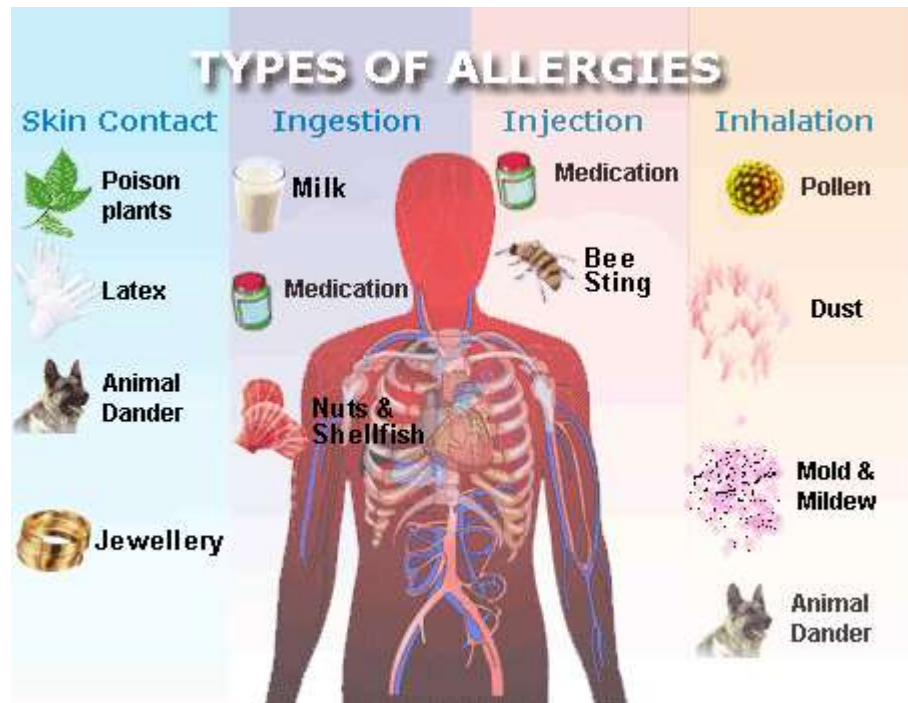
Interviewing of the patient: past medical history

- Use of inhalers (assess compliance and technique)
- Use of steroids (some measure of severity in asthma)
- Use of other drugs which may have relevance in respiratory disease, e.g. angiotensin-converting enzyme (ACE) inhibitors (cough)
- Childhood respiratory illnesses (e.g. asthma, pneumonia, TB)



Interviewing of the patient: allergies

- Food
- Inhaled allergens
- Drugs



Interviewing of the patient: occupational history

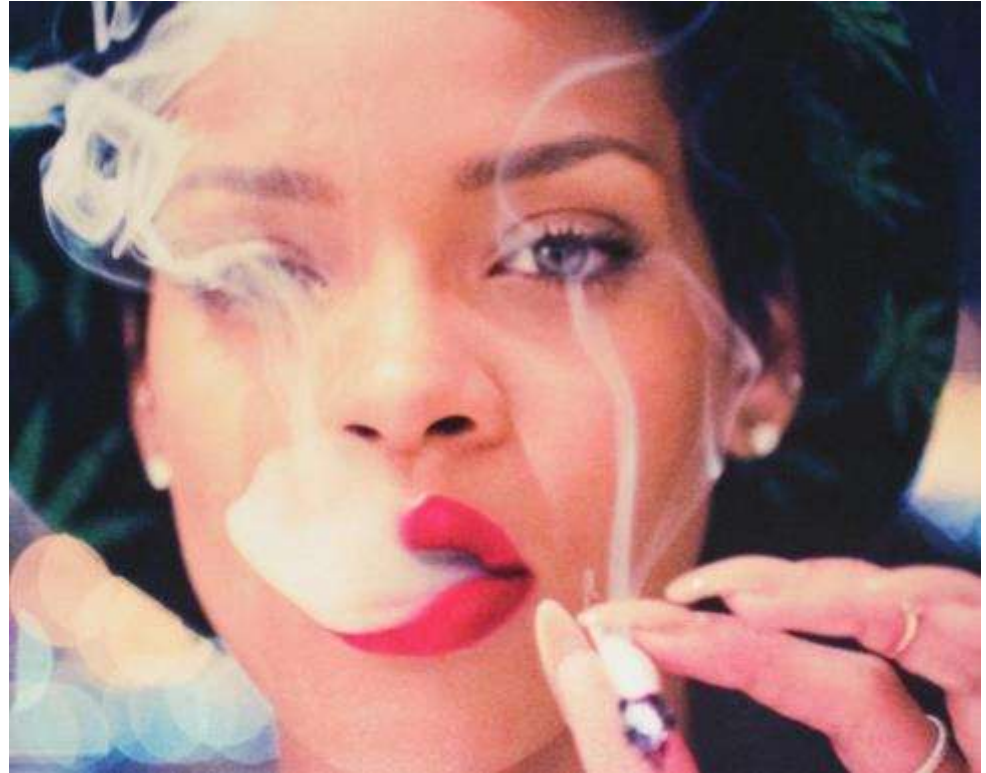
An occupational diseases (e.g. Occupational Asthma, Industrial Dust Diseases, Asbestos-related Diseases, Extrinsic Allergic Alveolitis, Sick Building Syndrome)

- Chronological listing of all jobs
- Precise job activities
- All materials used in job, with material safety data sheet (MSDS) if possible
- Duration and intensity of exposure
- Protective measures used, or breached
- Ventilation of workplace
- Timing relationship of symptoms with shift or vacation
- Other workers similarly affected



Interviewing of the patient: social history

- Environmental history (home - animals, humidifiers, heating)
- Lifestyle (alcohol consumption, illicit drugs)
- Smoking history (the type and number of cigarettes smoked currently and in the past, passive smoking)
- Sexual history (risk of HIV and AIDS)
- Ask about travels



Interviewing of the patient: family history

- Respiratory diseases with a genetic component, e.g. cystic fibrosis, emphysema (alpha-1-antitrypsin deficiency)
- Infectious diseases such as tuberculosis
- Atopic diseases such as asthma (hay fever, eczema)



Cystic Fibrosis Lung

Healthy Lung

Physical examination of the patient: general inspection

- The position of the patient
- Evidence of respiratory distress at rest or when walking, e.g. obvious breathlessness, talking in short phrases rather than full sentences, use of accessory muscles, exhalation with pursed lips, diaphragmatic paradox, intercostal indrawing
- Evidence of other respiratory symptoms, e.g. cough, audible wheeze.
- Does the patient appear to be pyrexial (check his temperature).
- Any indicators of recent weight loss, e.g. sunken cheeks



The patient in case of distress leans forward, resting his hands on his knees in what is known as the tri-pod position

Physical examination of the patient: hands inspection

- Finger clubbing
- Cyanosis
- Tobacco staining
- Pulse (tachycardia suggests significant respiratory difficulty or marked overuse of a beta agonist, lung cancer can cause atrial fibrillation, a large pneumothorax or a tension pneumothorax can cause pulsus paradoxus)
- Tremor (may indicate carbon dioxide retention)
- Osteoarthropathy



Physical examination of the patient: face inspection

- Cushingoid (as a result of long-term use of steroids)
- Central cyanosis
- Anaemia (conjunctivae)
- Horner's syndrome (possible apical lung cancer)



Physical examination of the patient: neck inspection

- Jugular venous pressure (e.g. cor pulmonale)
- Goitre (any possible tracheal obstruction)
- Lymphadenopathy
- Evidence of superior vena cava obstruction (may be caused by lung cancer)



Physical examination of the patient: chest inspection

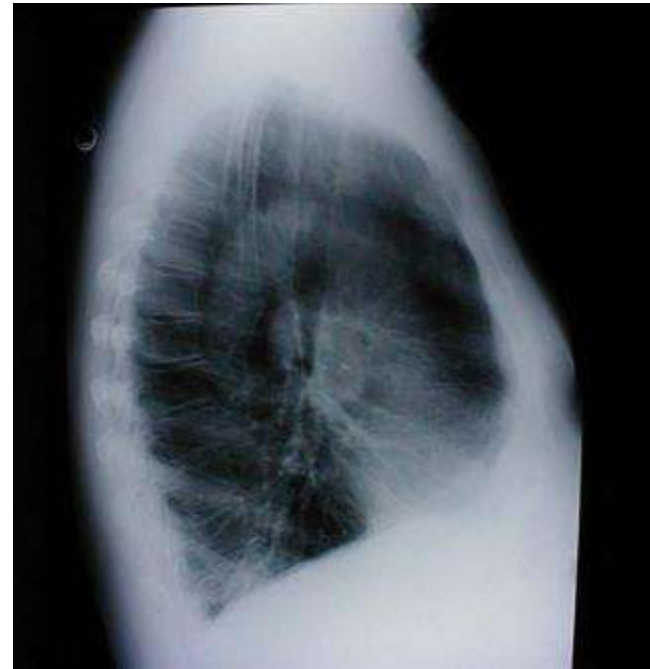
- Chest shape:
 - Overinflated (e.g. chronic obstructive pulmonary disease or severe acute asthma)
 - Asymmetry (the abnormality is on the side that moves less, e.g. pneumothorax, collapse, consolidation or effusion)
 - Deformity (pigeon chest (pectus carinatum), funnel chest (pectus excavatum), kyphosis and/or scoliosis)
- Respiratory rate for an adult:
 - normal is about 14/min
 - tachypnea > 28/min
 - bradypnea < 10/min
- Respiratory distress (difficulty in breathing)
- Pathological breathing
 - Kussmaul's (deep and labored, associated with metabolic acidosis)
 - Cheyne-Stokes (progressively deeper breathing followed by temporary apnoea, may occur with heart failure, cerebrovascular disease, head injury, carbon monoxide poisoning or brain tumors, or be a normal variant during sleep or at high altitude)
- Scars
- Paradoxical chest movement (may indicate a fractured rib)

Physical examination of the patient: chest inspection



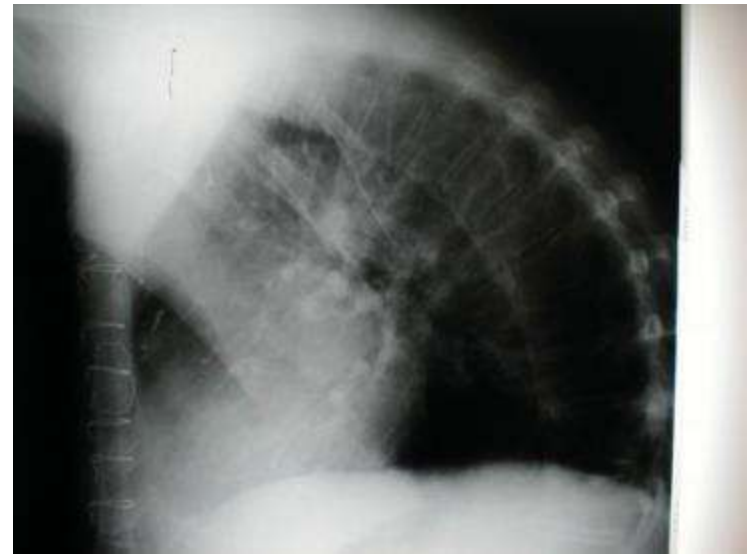
Pectus excavatum: congenital posterior displacement of lower aspect of sternum

Physical examination of the patient: chest inspection



Barrel chest: associated with emphysema and lung hyperinflation

Physical examination of the patient: chest inspection



Kyphosis: causes the patient to be bent forward

Physical examination of the patient: chest inspection



Scoliosis: condition where the spine is curved to either the left or right

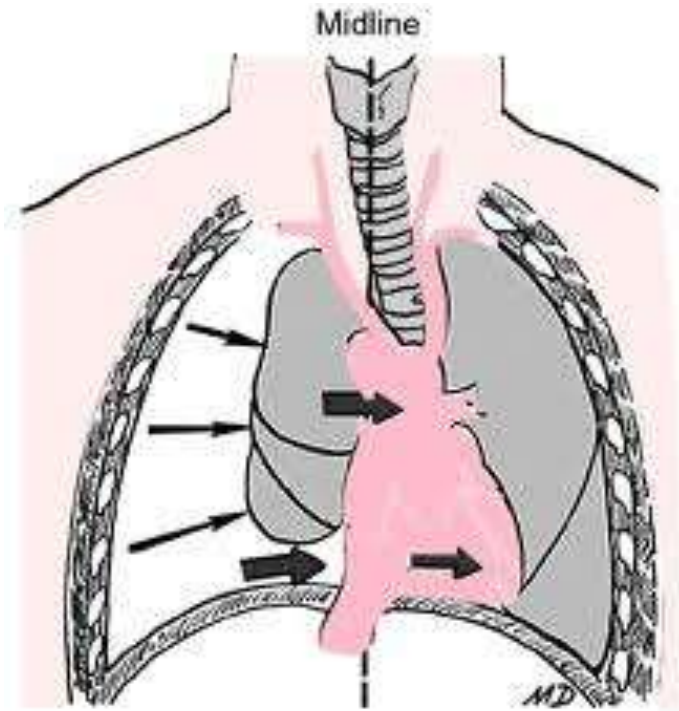
Physical examination of the patient: abdomen and lower limbs inspection

- Hepatomegaly (may indicate right heart failure)
- Ascites (may indicate end stage right heart failure)
- Swollen calf (possible deep vein thrombosis)
- Peripheral oedema (lower legs if ambulant or sacral if bed-bound)



Physical examination of the patient: the trachea palpation

- Use the index finger to feel the trachea and to determine whether the trachea feels central or is deviated
- The trachea is deviated away from pneumothorax and effusion and towards collapse and consolidation
- The trachea may also be deviated by a mass, e.g. enlarged lymph nodes



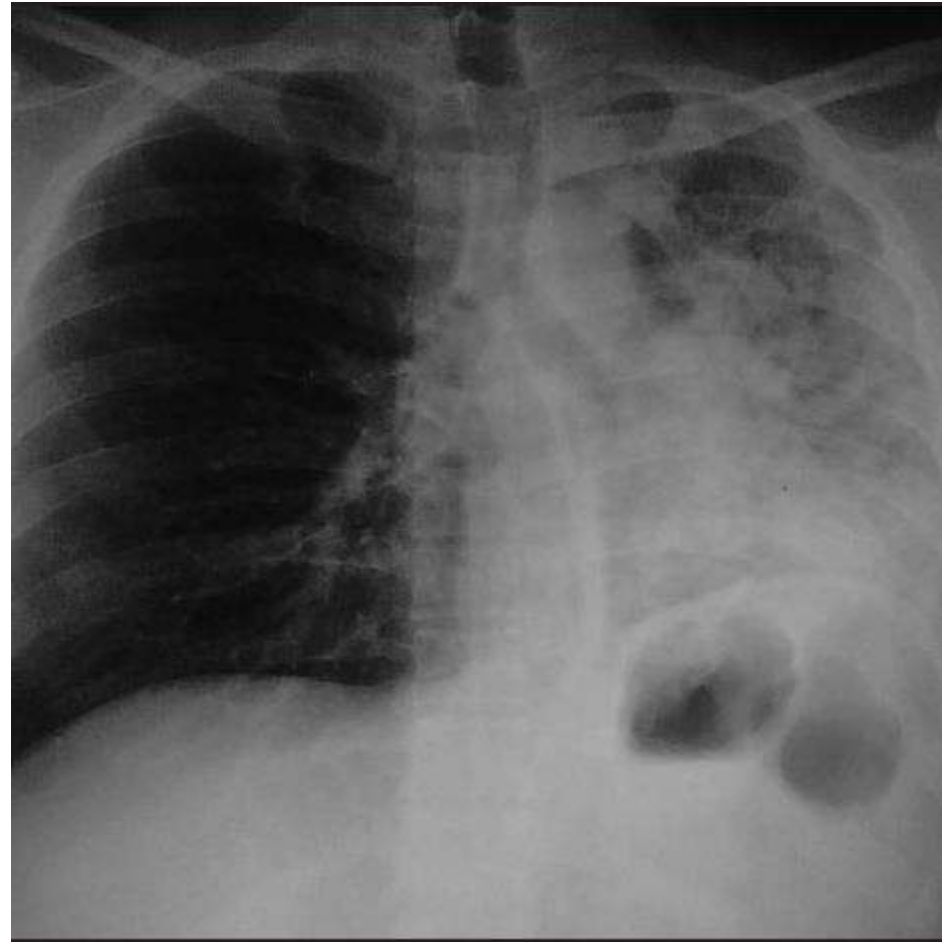
Physical examination of the patient: the trachea palpation



If it is deviated, it may suggest a tumor or pneumothorax

Physical examination of the patient: chest palpation

- Chest expansion in an adult usual is 4-5 cm and should be symmetrical
- Symmetrical reduction of chest wall expansion in overinflated lungs (e.g. bronchial asthma, emphysema), stiff lungs (e.g. pulmonary fibrosis), ankylosing spondylitis
- Asymmetrical reduction of chest wall expansion: absent expansion (e.g. empyema and pleural effusion) or reduced expansion (e.g. pulmonary consolidation and collapse)



Physical examination of the patient: chest palpation



Supra and infra clavicular lymph nodes

Physical examination of the patient: chest palpation



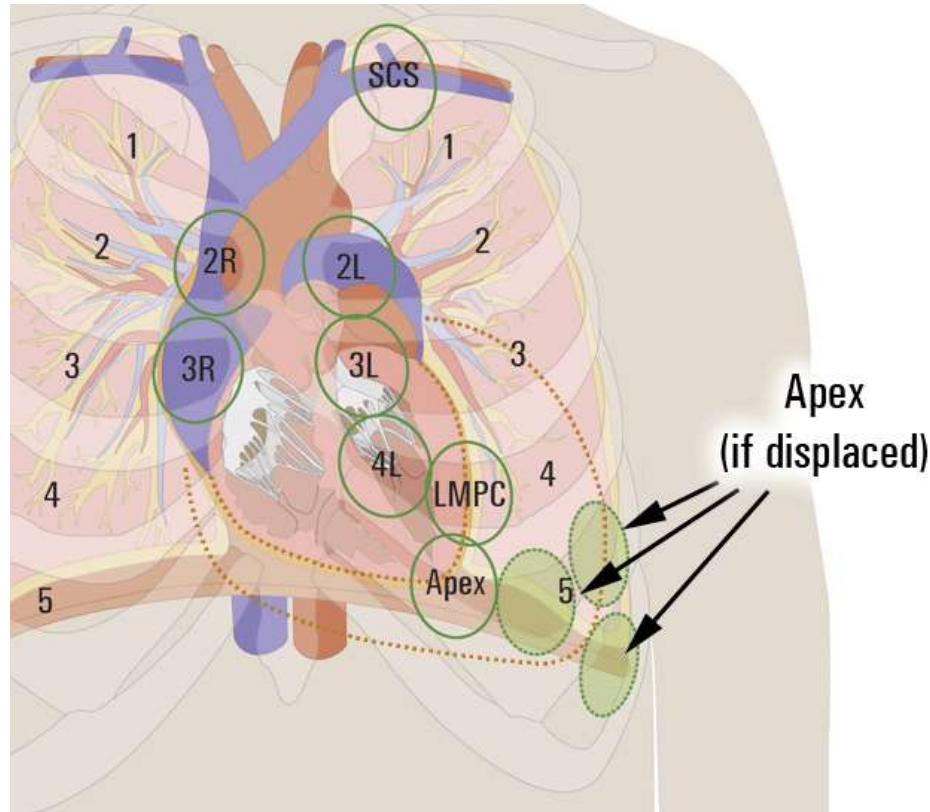
Detecting chest excursion: place your hands on the patient's back
with thumbs pointed towards the spine

Physical examination of the patient: vocal fremitus palpation

- To assess tactile vocal fremitus, use the ulnar side of the hand, by the hypothenar eminence with the palms facing upwards. Place it at various levels over the back, each time asking the patient to say "ninety-nine"
- Note how the sound is transmitted to the hand
- Tactile vocal fremitus is increased over areas of consolidation and decreased or absent over areas of effusion or collapse



Physical examination of the patient: heart apex palpation



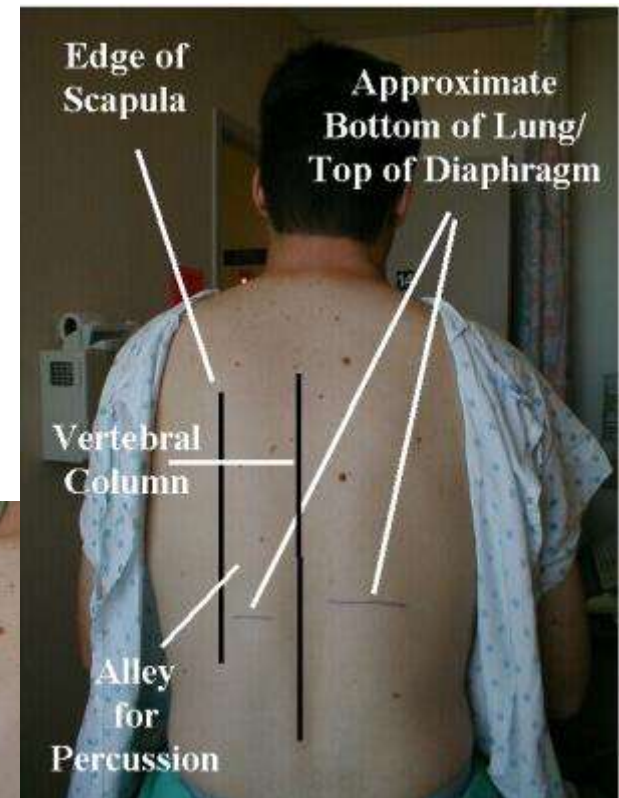
- Feel for the apex beat of the heart
- It will be displaced if the mediastinum is displaced or distorted

Physical examination of the patient: the chest percussion

- For percussion it is usual to use the middle finger of the dominant hand to do this
- The clavicle is percussed directly
- The rest of the chest is percussed by placing the non-dominant hand on the chest and using the dominant middle finger to tap the other middle finger over the middle phalanx
- Percuss over all the lobes of the lung, front and back except that the middle lobe does not have surface anatomy on the back
- Percuss over the heart: in hyperinflation of the chest, there is loss of cardiac dullness.
- A hyper-resonant sound suggests hyperinflation or a pneumothorax
- A dull sound is easier to distinguish from normal: it may suggest collapse or consolidation, or a pleural effusion

Physical examination of the patient: the chest percussion

- This technique makes use of the fact that striking a surface which covers an air-filled structure (e.g. normal lung) will produce a resonant note while repeating the same maneuver over a fluid or tissue filled cavity generates a relatively dull sound



Physical examination of the patient: main heart and lungs sounds in auscultation

- Heart auscultation is used to detect heart abnormalities, pulmonary hypertension and a loud P2
- In lungs auscultation the stethoscope is placed over each of the 5 lobes of the organ in turn, on the front and back of the chest, ask the patient to take deep breaths in and out with their mouth open
- Normal breath sounds are called vesicular, they are described as quiet and gentle, there is usually no gap between the inspiratory and expiratory phase sounds
- Rhonchi (wheezes):
 - Musical sound heard on expiration, in severe cases they may be both inspiratory and expiratory, imply narrowing of the airways
 - The loudness of rhonchi gives no indication of the severity of the condition

Physical examination of the patient: normal breath sounds

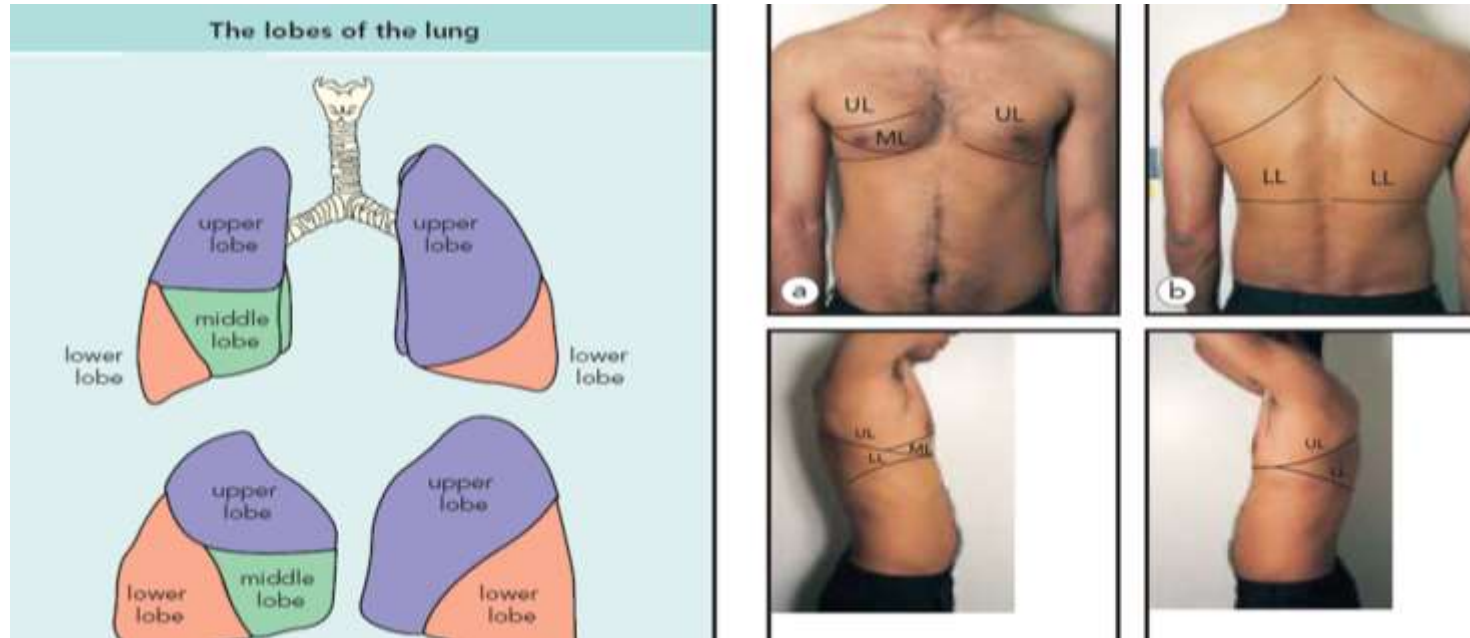
- **Bronchial** : Heard over the trachea and mainstem bronchi (2nd-4th intercostal spaces either side of the sternum anteriorly and 3rd-6th intercostal spaces along the vertebrae posteriorly). The sounds are described as tubular and harsh. Also known as tracheal breath sounds.
- **Bronchovesicular** : Heard over the major bronchi below the clavicles in the upper of the chest anteriorly. Bronchovesicular sounds heard over the peripheral lung denote pathology. The sounds are described as medium-pitched and continuous throughout inspiration and expiration.
- **Vesicular** : Heard over the peripheral lung. Described as soft and low- pitched. Best heard on inspiration.
- **Diminished/absent**: Heard with shallow breathing:
 - normal in obese patients with excessive adipose tissue and during pregnancy.
 - abnormal:
 - air or fluid in or around the lungs (such as pneumonia, heart failure, and pleural effusion)
 - over-inflation of a part of the lungs (emphysema can cause this)
 - reduced airflow to part of the lungs
 - obstructed airway, partial or total lung collapse, or chronic lung disease.

Physical examination of the patient: main heart and lungs sounds in auscultation

- Prior to listening over any one area of the chest, remind yourself which lobe of the lung is heard best in that region: lower lobes occupy the bottom 3/4 of the posterior fields; right middle lobe heard in right axilla; lingula in left axilla; upper lobes in the anterior chest and at the top 1/4 of the posterior fields
- Many disease processes (e.g. pulmonary edema, bronchoconstriction) are diffuse, producing abnormal findings in multiple fields



Physical examination of the patient: main heart and lungs sounds in auscultation



Prior to listening over any one area of the chest, remind yourself which lobe of the lung is heard best in that region: lower lobes occupy the bottom 3/4 of the posterior fields; right middle lobe heard in right axilla; lingula in left axilla; upper lobes in the anterior chest and at the top 1/4 of the posterior fields

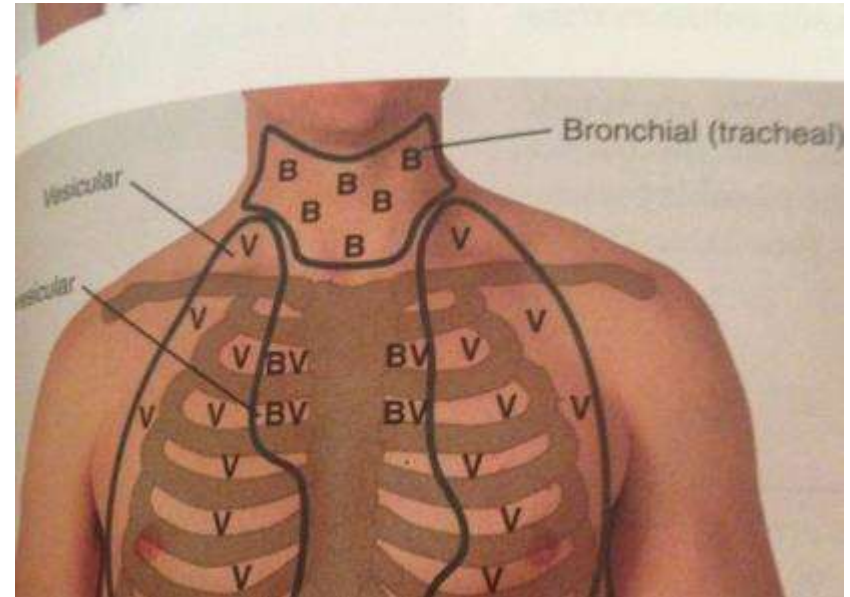
Physical examination of the patient: main heart and lungs sounds in auscultation

Many disease processes (e.g. pulmonary edema, bronchoconstriction) are diffuse, producing abnormal findings in multiple fields



Physical examination of the patient: bronchial breathing in auscultation

- The sounds of bronchial breathing are generated by turbulent air flow in large airways (similar sounds can be heard in healthy patients by listening over the trachea)
- Sounds are harsh and poor in nature, unlike normal vesicular breath sounds, there is a gap between the inspiratory and expiratory phase sounds
- bronchial breathing suggests consolidation or fibrosis, cavitation, complete alveolar atelectasis with patent airways, mass interposed between chest wall and large airways which permit the sound to be conducted more effectively to the chest wall



V- vesicular, B - bronchial

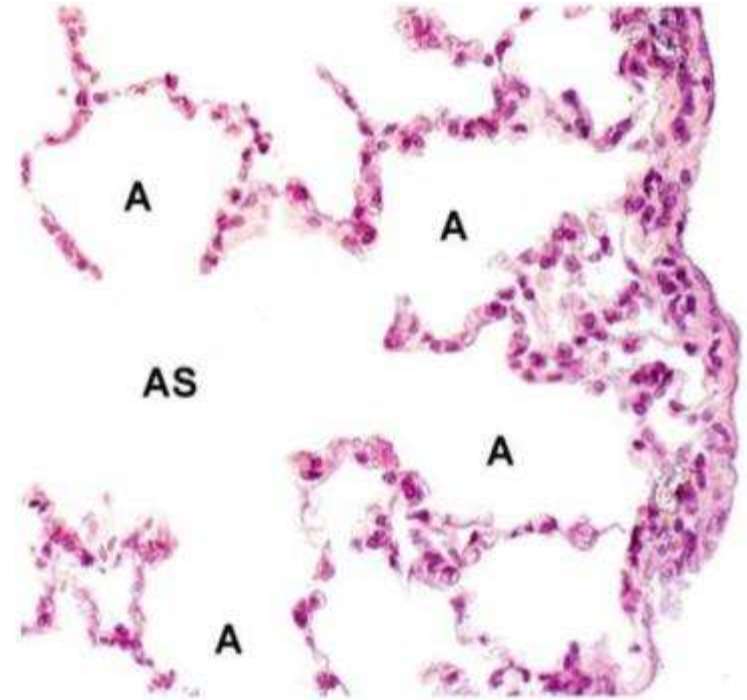
Physical examination of the patient: adventitious breath sounds

- Adventitious breath sounds are abnormal sounds that are heard over a patient's lungs and airways
- These sounds include:
 - fine and coarse crackles (crackles are also called rales)
 - wheezes (sometimes called rhonchi)
 - pleural rubs
 - stridor

Physical examination of the patient: rales (crackles) in auscultation

Rales

- Probably represent opening of small airways and alveoli
- Are heard more commonly during inspiration than expiration
- Imply either accumulation of fluid secretions or exudate within airways or inflammation and edema in the pulmonary tissue
- May be normal at the lung bases if they clear on coughing or after taking a few deep breaths
- Basal rales are a classical feature of pulmonary congestion with left ventricular failure, they may be more diffuse in pulmonary fibrosis



Alveolar sac with alveoli

Physical examination of the patient: wheezes (rhonchi) in auscultation

- Result as a collapsed airway lumen gradually opens during inspiration or gradually closes during expiration
 - Are continuous musical tones that are most commonly heard at end inspiration or early expiration
 - Imply decreased airway lumen diameter (obstruction) either due to thickening of reactive airway walls or collapse of airways due to pressure from surrounding pulmonary disease
- High pitch wheezes (= wheezes = sibilant wheezes)
- shrill sounding breath sounds, often have a musical quality
 - heard during exhalation, in *severe blockage also are heard during inhalation*
 - are associated with partial blockage of the small airways
- Low pitch wheezes (= rhonchi = sonorous wheeze)
- a snoring, gurgling quality
 - associated with disease of larger airways
 - heard primarily in exhalation
 - *disappears with coughing*
 - caused by blockages to the main airways by mucous, lesions, or foreign bodies (pneumonia, chronic bronchitis, cystic fibrosis)

Physical examination of the patient: pleural rub in auscultation

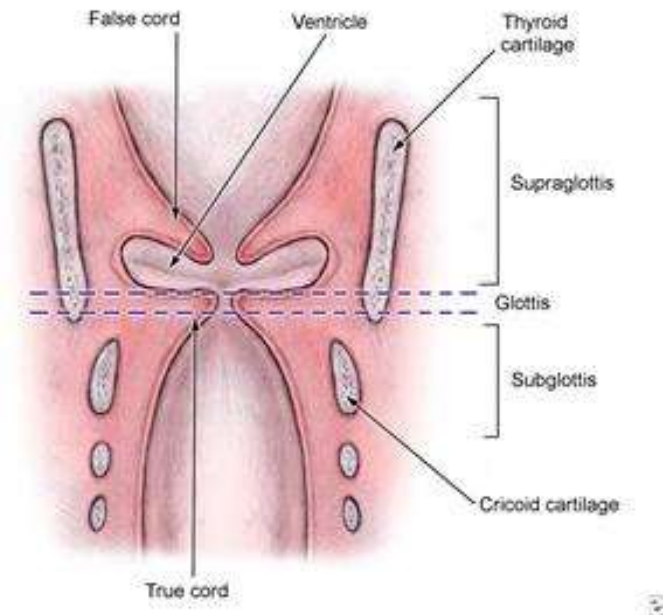


Pleural rub means a creaking sound caused by stiff pleural membranes

Here Laennec auscultates a patient before his students (1816, Painting by Théobald Chartran)

Physical examination of the patient: stridor in auscultation

- Stridor means harsh inspiratory sound caused by upper airway (large airway) narrowing or partial obstruction
- The common causes of stridor are pertussis, croup, epiglottitis, aspirations
- Here is demonstrated congenital laryngeal stridor as the result of poor development of the child's throat cartilage



Physical examination of the patient: vocal resonance in auscultation



- Place the stethoscope at various levels over the back and ask the patient to whisper "ninety-nine" each time
- Note how well the sound is transmitted
- The sound is muffled over a normal lung, increased if there is consolidation, and decreased or absent if there is effusion or collapse

Physical examination of the patient: whispering pectoriloquy in auscultation



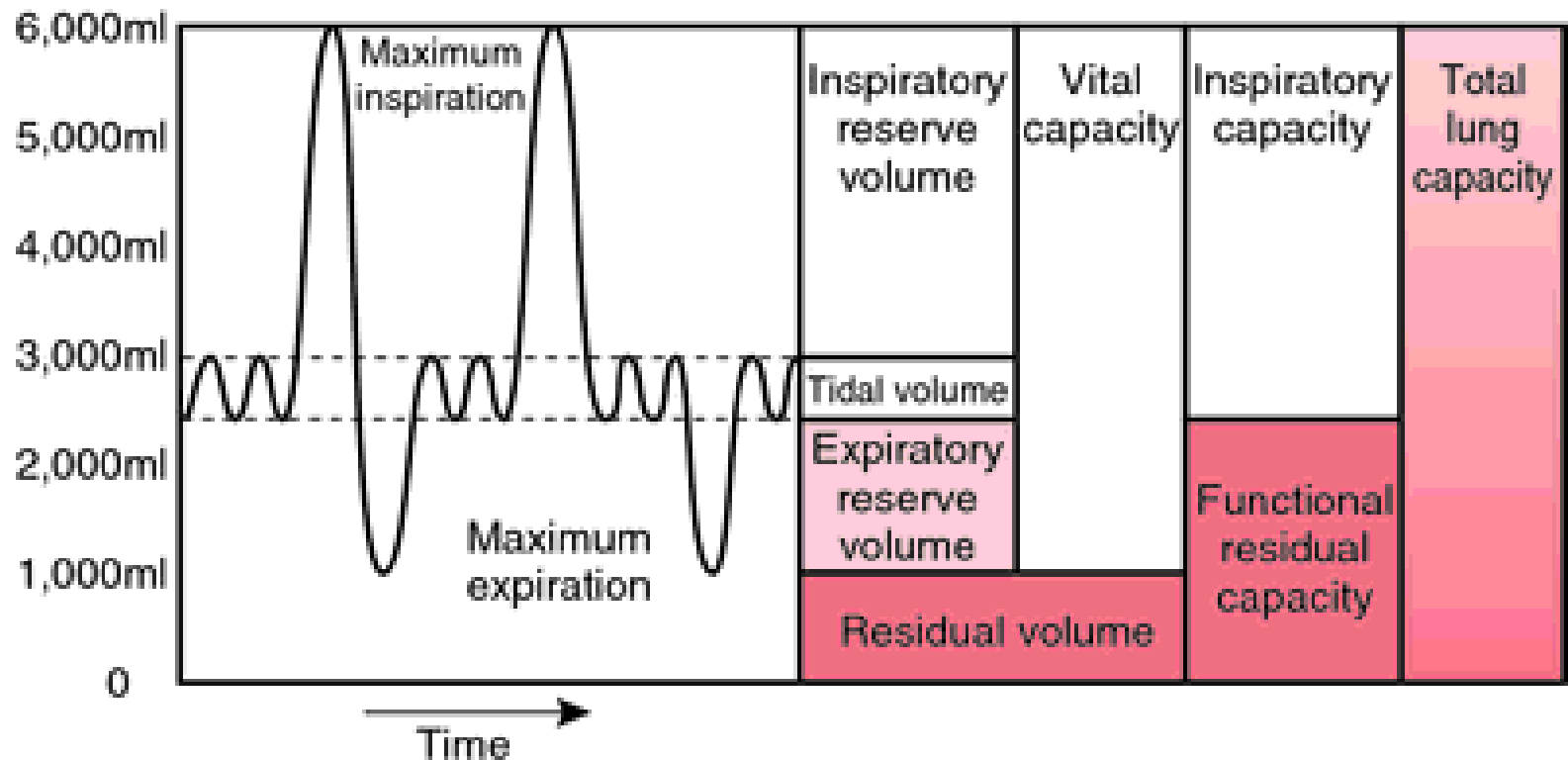
- Is elicited as for vocal fremitus but ask the patient to whisper "one, two, three"
- Whispering pectoriloquy is the increased quality and loudness of whispers that are heard with a stethoscope over an area of lung consolidation

Instrumental methods for evaluating of the patient status: spirometry

- A spirometer is a device for measuring timed expired and inspired volumes and is the gold standard for the diagnosis, assessment and monitoring of chronic obstructive pulmonary disease (COPD) and asthma
- The reduced expiratory volume in one second (FEV1) is a marker of cardiovascular mortality

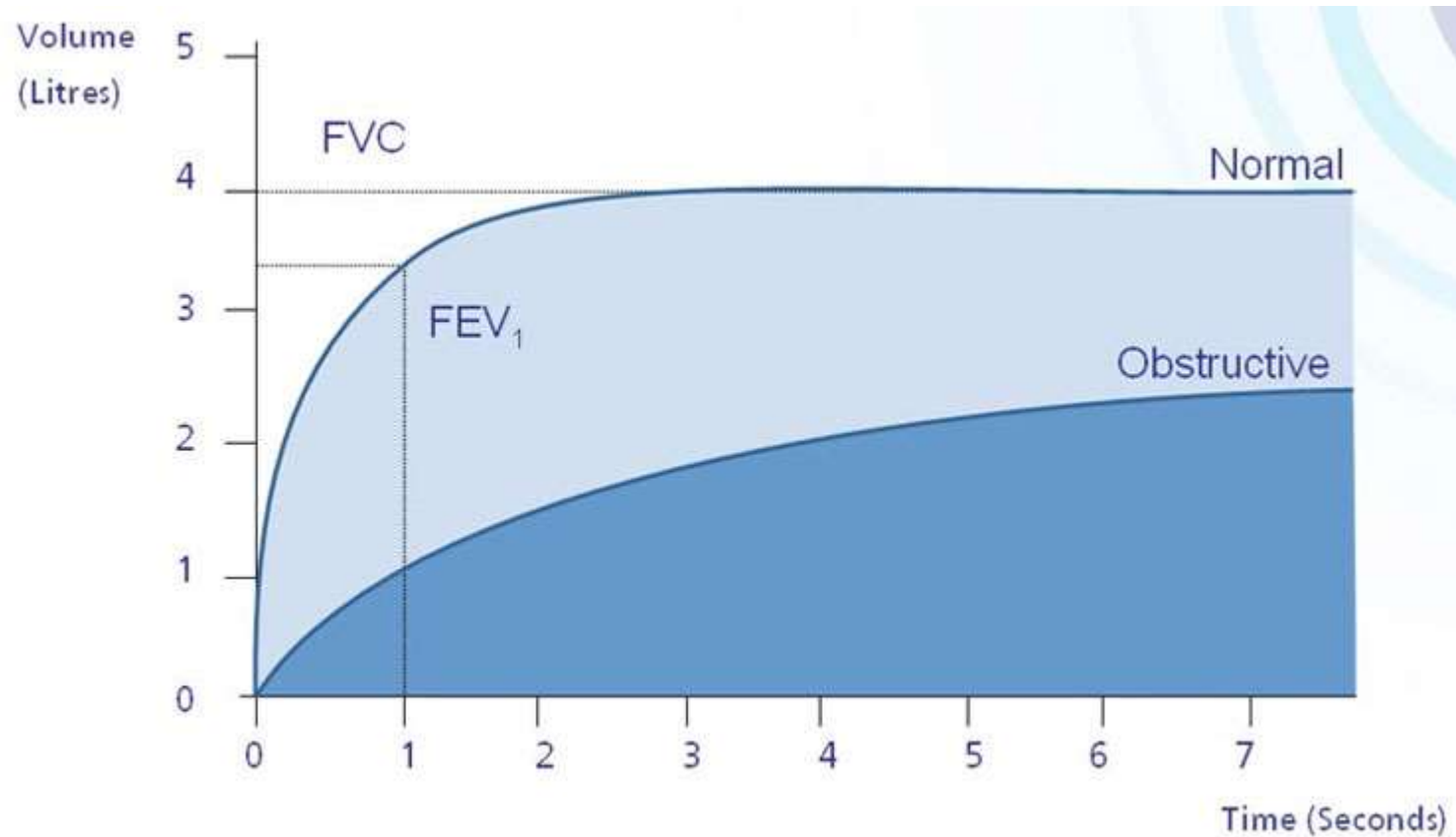


Instrumental methods for evaluating of the patient status: spirometry



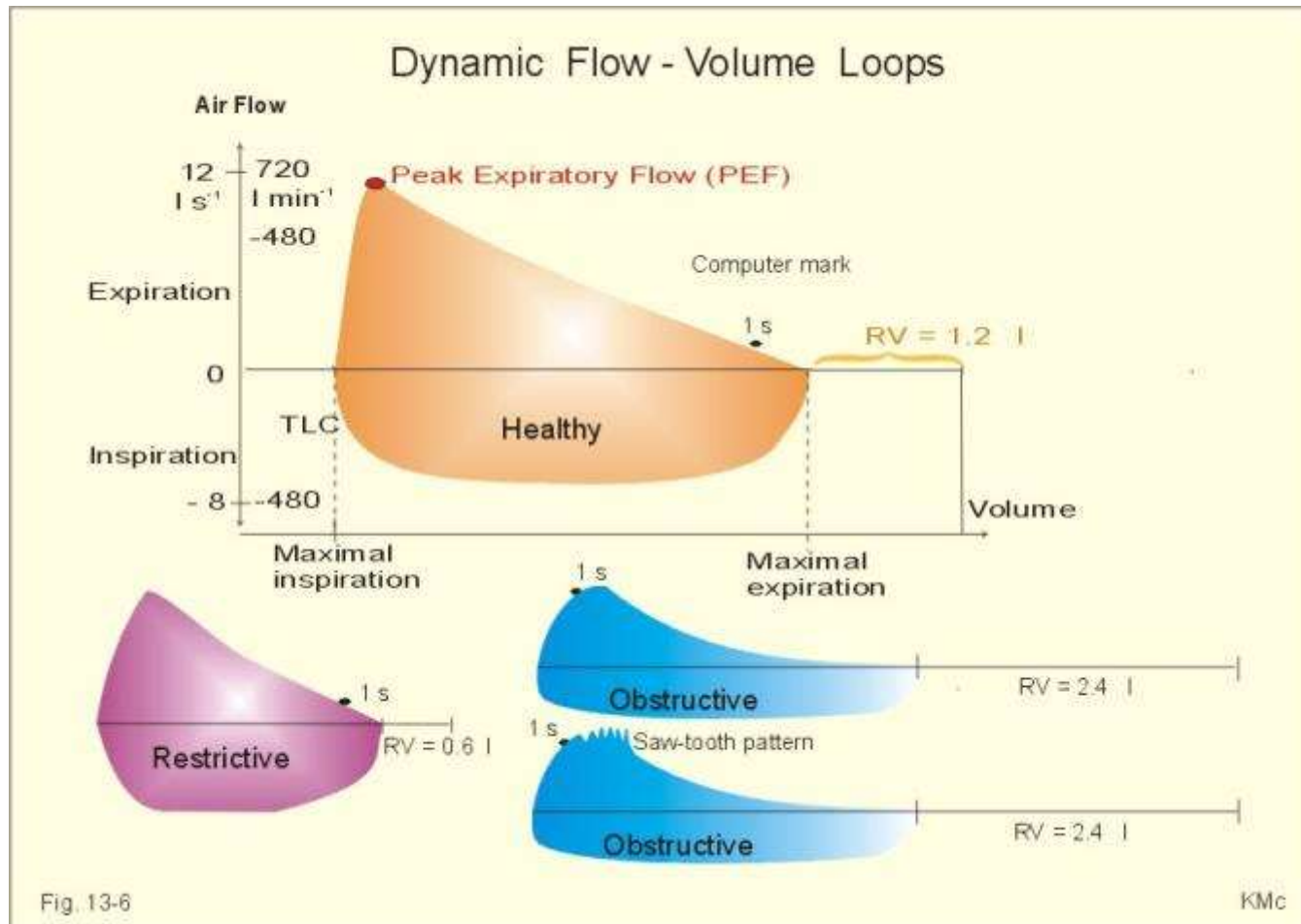
Incentive spirometry

Instrumental methods for evaluating of the patient status: spirometry



The time volume curve

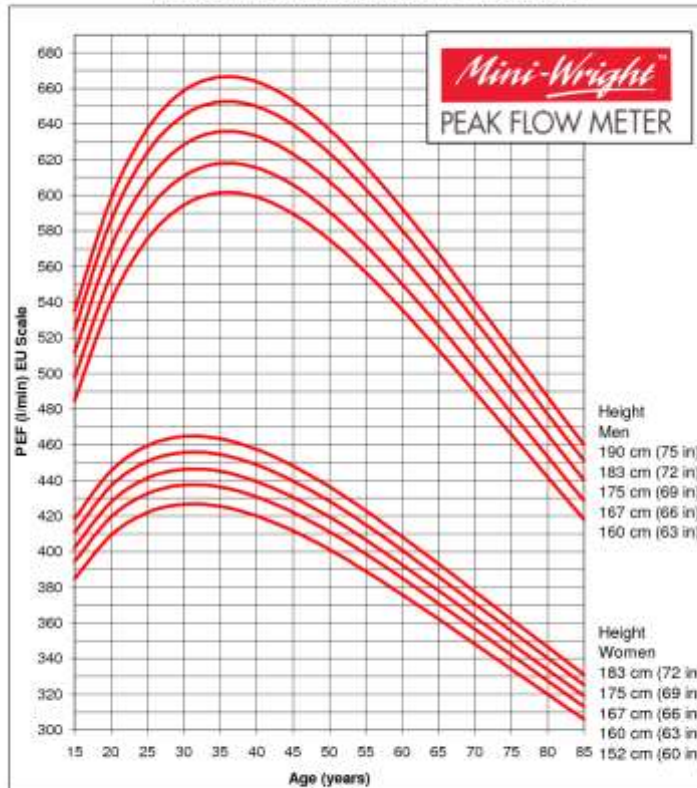
Instrumental methods for evaluating of the patient status: spirometry



Expiratory flow loop

Instrumental methods for evaluating of the patient status: peak expiratory flow

PEAK EXPIRATORY FLOW RATE - NORMAL VALUES
For use with EU/EN13826 scale PEF meters only



Adapted by Clement Clarke for use with EN13826 / EU scale peak flow meters from Nunn AJ Gregg I, Br Med J 1989;298:1068-70

In men, readings up to 100 L/min lower than predicted are within normal limits. For women, the equivalent figure is 85 L/min. Values are derived from Caucasian populations.

Mini-Wright
(Standard Range)
EU scale
(EN 13826)

Blue text
on a yellow
background



Single Patient Use
Part Ref: 3103388

Multiple Patient Use
Part Ref: 3103387

NHS Logistics
Code : FDD 609

Mini-Wright
(Low Range)
EU scale

Blue text
on a yellow
background



Single Patient Use
Part Ref: 3104708

Multiple Patient Use
Part Ref: 3104710

Clement Clarke has developed mathematical equations that will allow conversion of P.E.F. readings from Wright-McKerrow scale to EN 13826 scale, and vice-versa. Contact us directly, or visit the website

www.peakflow.com

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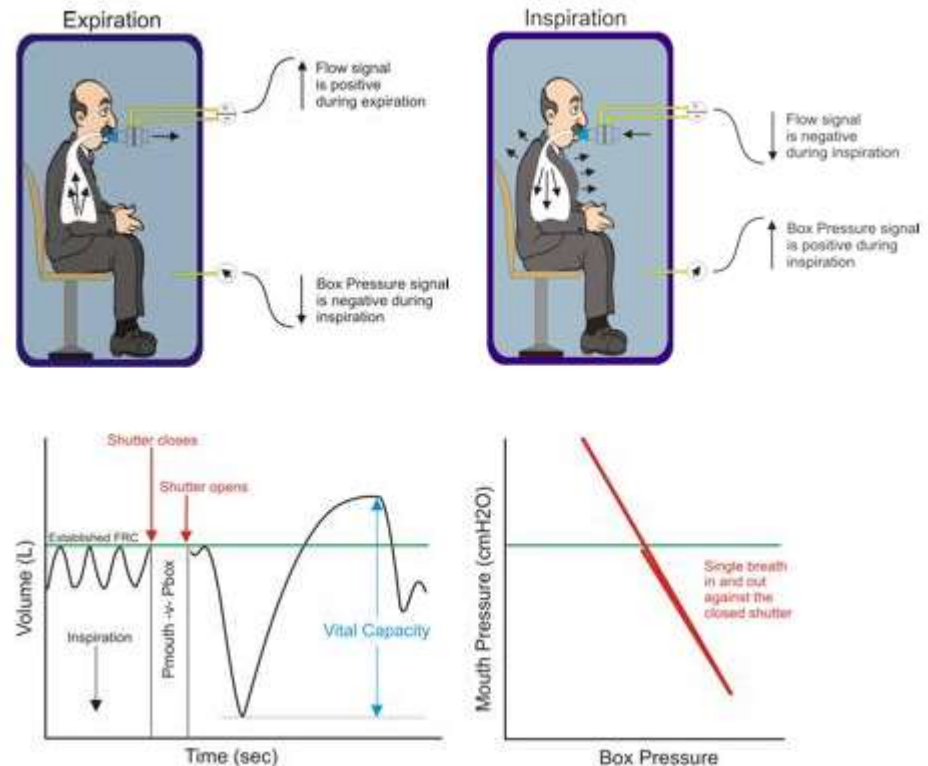
(Issue 1 Date of preparation: 23rd July 2004)

Peak flow monitoring is recommended in the diagnosis of asthma
and exacerbations

<http://patient.info/doctor/Respiratory-System-History-and-Exam.htm> <http://www.docstoc.com/docs/91602115/PEAK-EXPIRATORY-FLOW-RATE---NORMAL-VALUES>

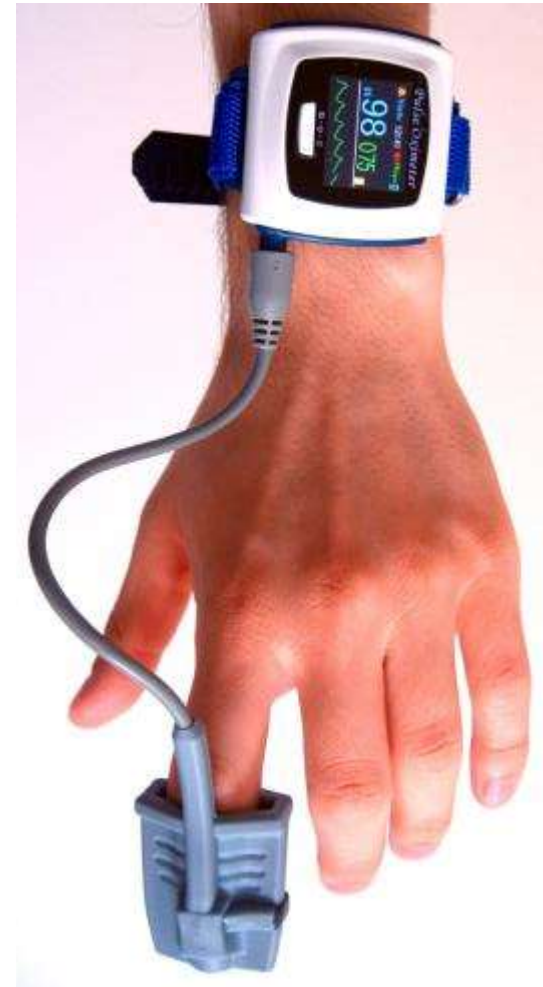
Instrumental methods for evaluating of the patient status: body plethysmography

- The ultimate way to measure lung volumes is body plethysmography
- With this instrument, the volumes of the lungs are evaluated by pressure change
- Body plethysmography is the most accurate means available at this time to assess lung volumes because it is not limited by air trapping

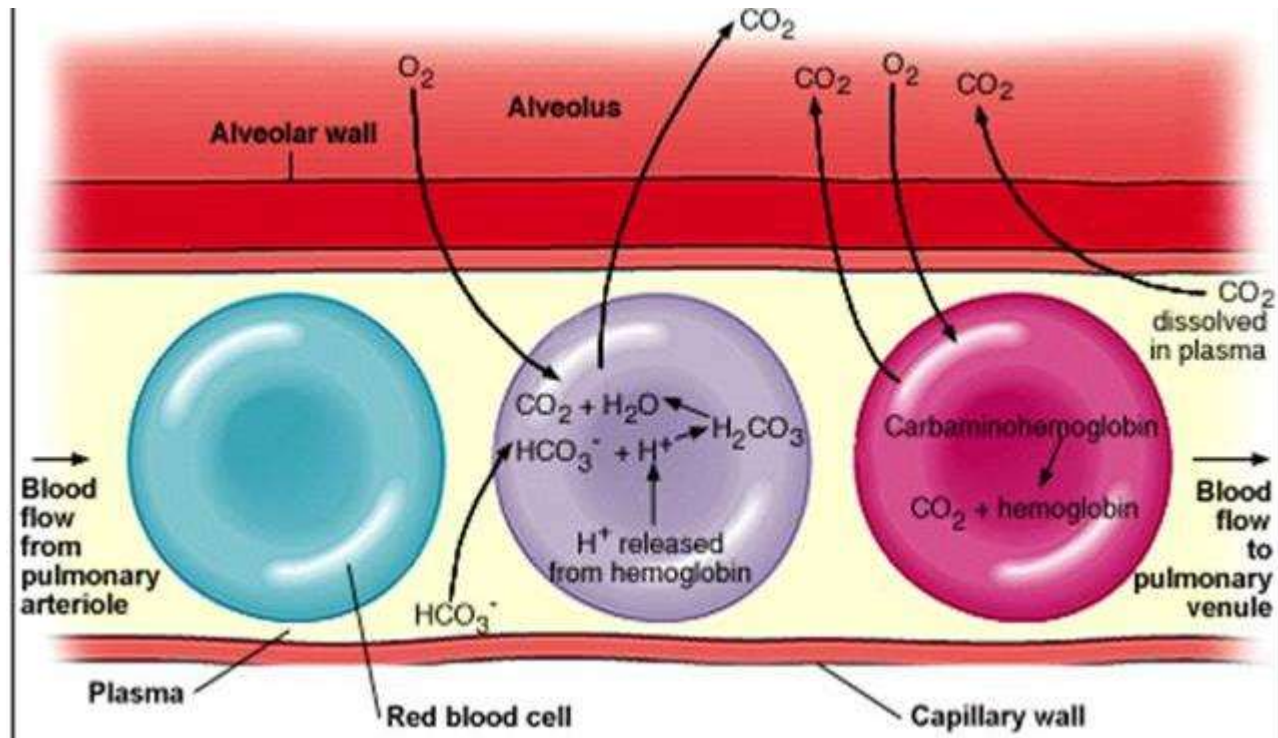


Instrumental methods for evaluating of the patient status: pulse oxymeter

A pulse oxymeter is a device that continuously measures heart rate and oxygen saturation as a dynamic extension of the cardiac and pulmonary examinations

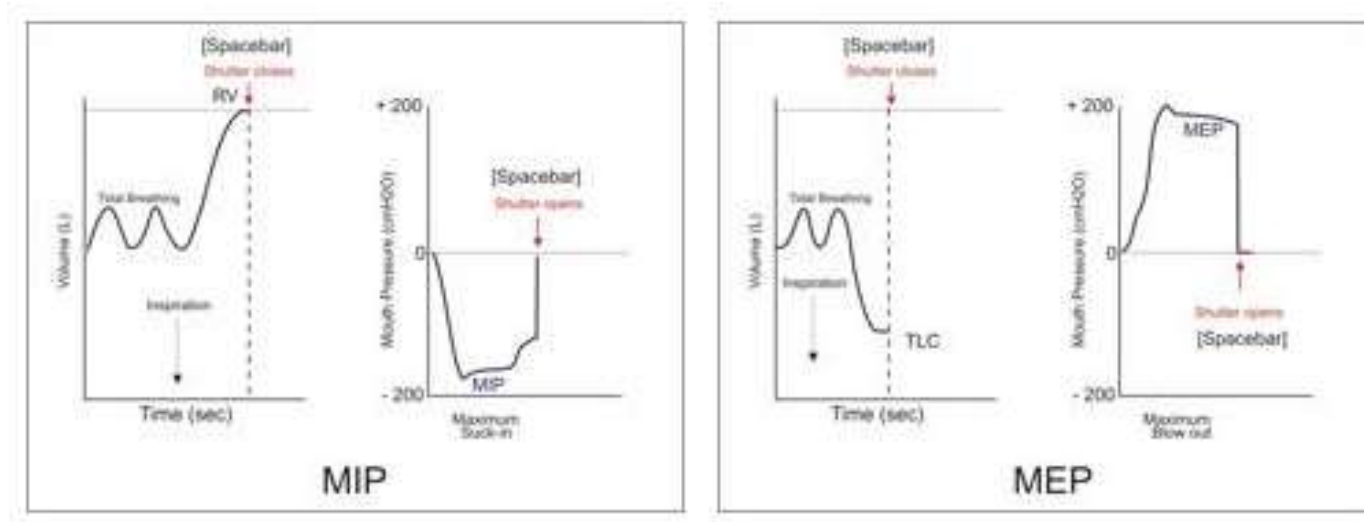


Instrumental methods for evaluating of the patient status: diffusing capacity of the lungs



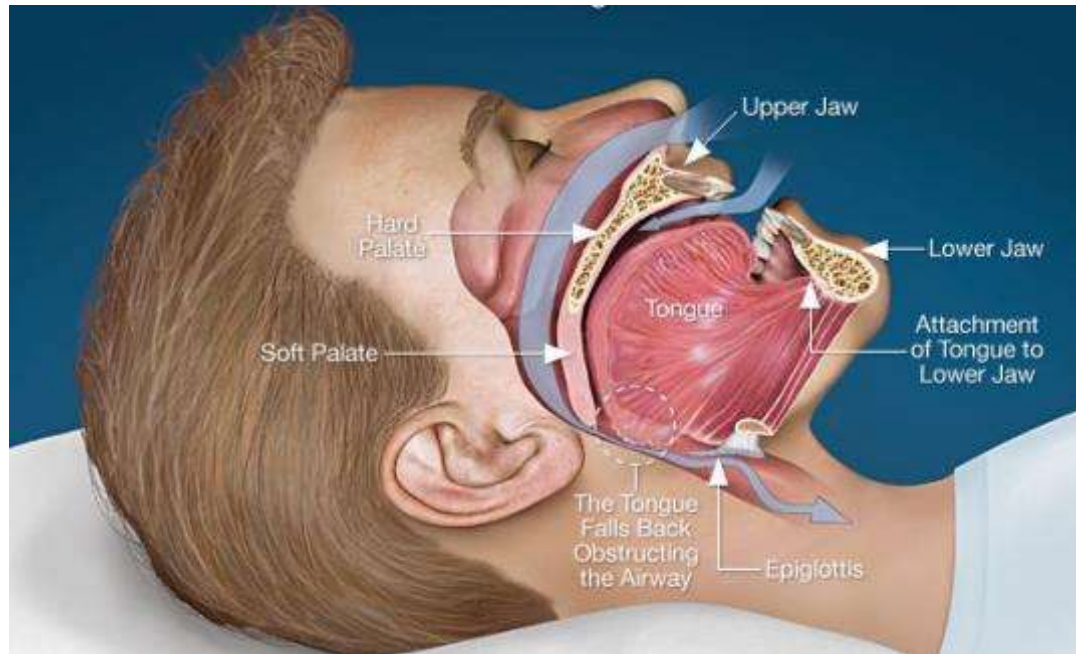
- Diffusing capacity of the lungs measures the transfer of gas from air in the lungs, to the red blood cells in lung blood vessels
- It is part of a comprehensive series of tests to determine the overall ability of the lung to transport gas into and out of the blood

Instrumental methods for evaluating of the patient status: respiratory muscle strength



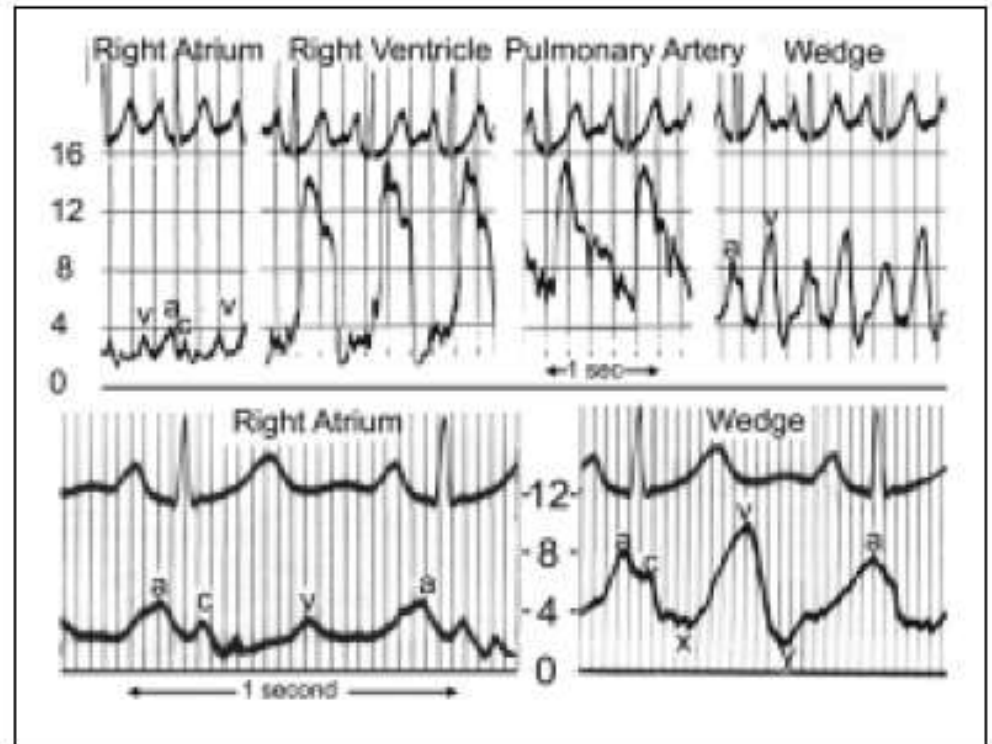
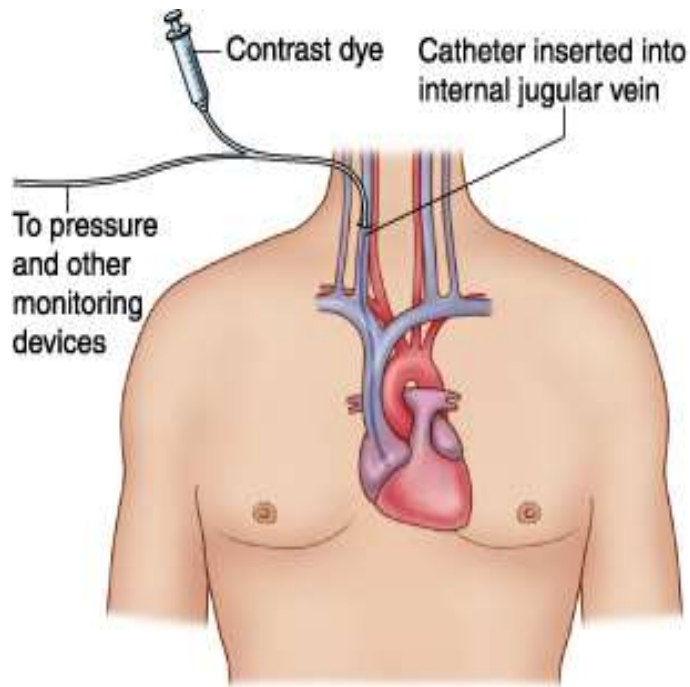
- Respiratory muscle function is commonly assessed by measuring maximal pressures generated at the mouth during maximal inspiratory and expiratory efforts against an occluded airway
- The test is often called MIP/MEP - maximum inspiratory and expiratory pressure

Instrumental methods for evaluating of the patient status: obstructive sleep apnea



- Obstructive sleep apnea is a sleep disorder characterized by pauses in breathing or instances of shallow or infrequent breathing during sleep
- Each pause in breathing (an apnea) can last to several minutes, and may occur at least 5 times in an hour

Instrumental methods for evaluating of the patient status: right heart catheterisation



Right heart catheterisation is used in the differential diagnosis of pulmonary hypertension

Instrumental methods for evaluating of the patient status: intensive care monitoring



The measurement of special parameters (*e.g.* tidal volume, inspiratory and expiratory pressures) in mechanically ventilated patients

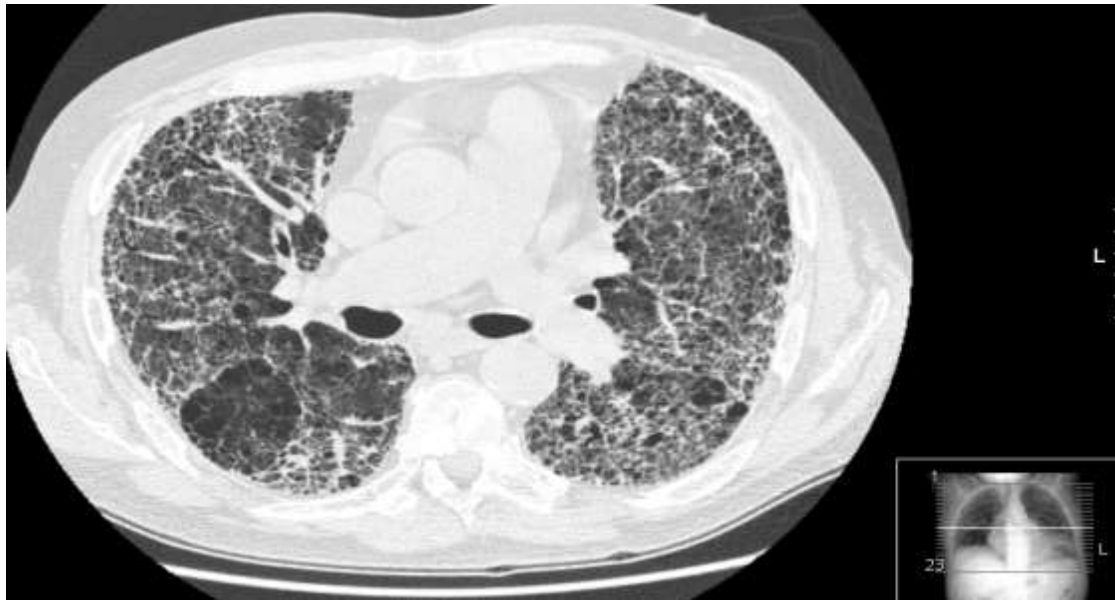
Instrumental methods for evaluating of the patient status: chest (x-ray) radiography

- The chest x-ray is the most commonly performed noninvasive medical test that helps physicians diagnose and treat medical condition
- A chest x-ray produces images of the heart, lungs, airways, blood vessels and the bones of the spine and chest



Increased opacity in R paracardiac space

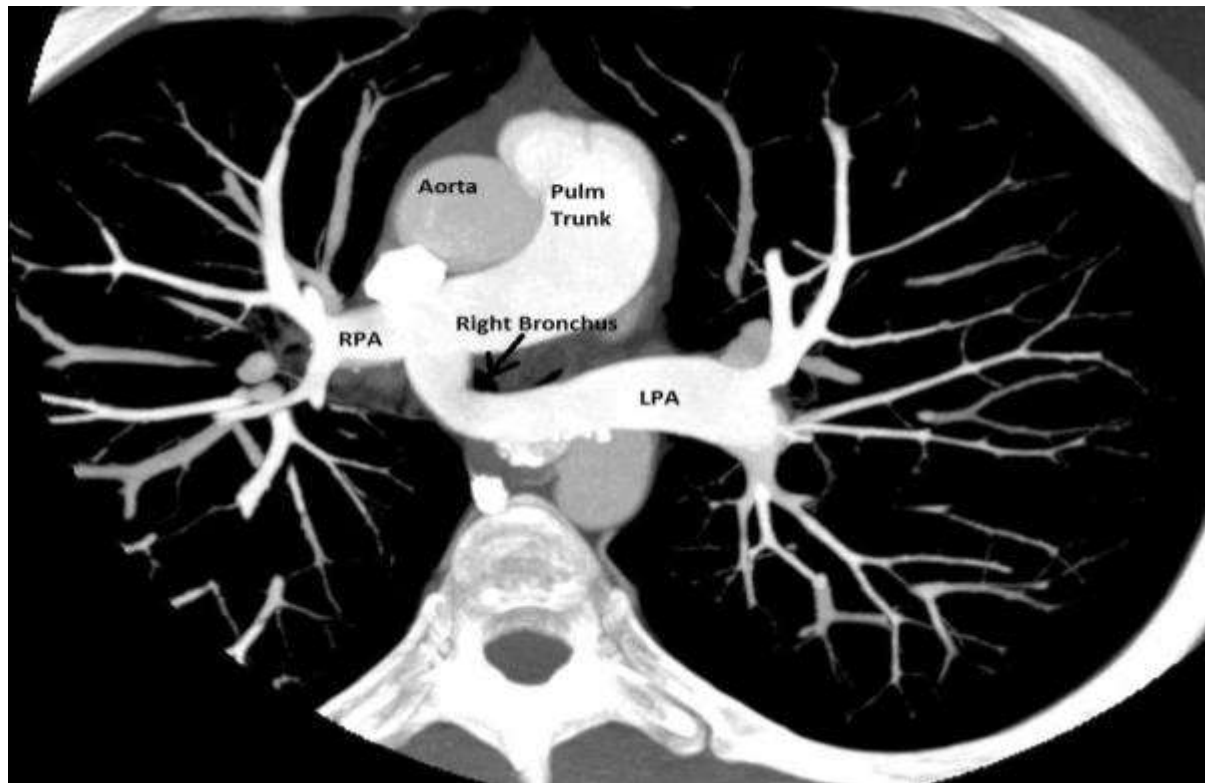
Instrumental methods for evaluating of the patient status: chest computed tomography



Pulmonary fibrosis

- Computed tomography (CT) of the chest is performed (in suspected pulmonary embolism cases, for example)
- CT is helpful for guiding needle aspiration of peripheral lung lesions
- High-resolution CT has improved the diagnosis of diffuse interstitial lung disease considerably

Instrumental methods for evaluating of the patient status: pulmonary and bronchial angiography



Pulmonary and bronchial angiography are invasive techniques for imaging vessels and are used if less invasive techniques fail or need to be confirmed

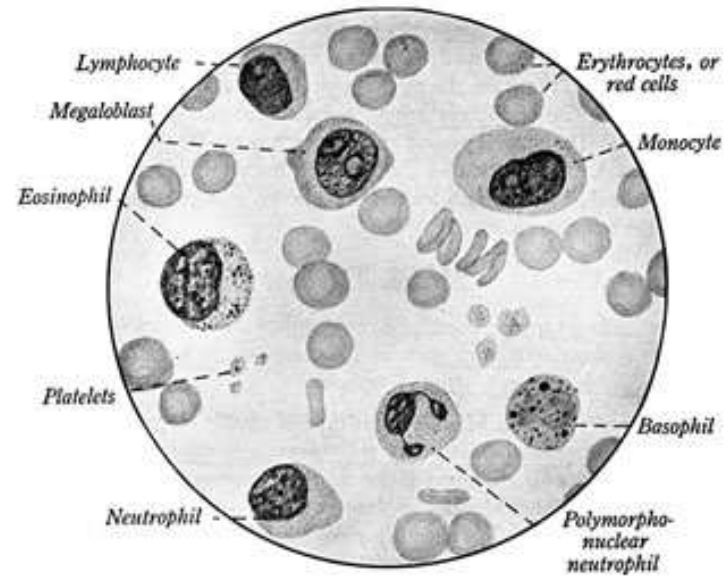
Instrumental methods for evaluating of the patient status: bronchoscopy



The procedure not only allows inspection and sampling of the airways, but also facilitates transbronchial lung biopsy

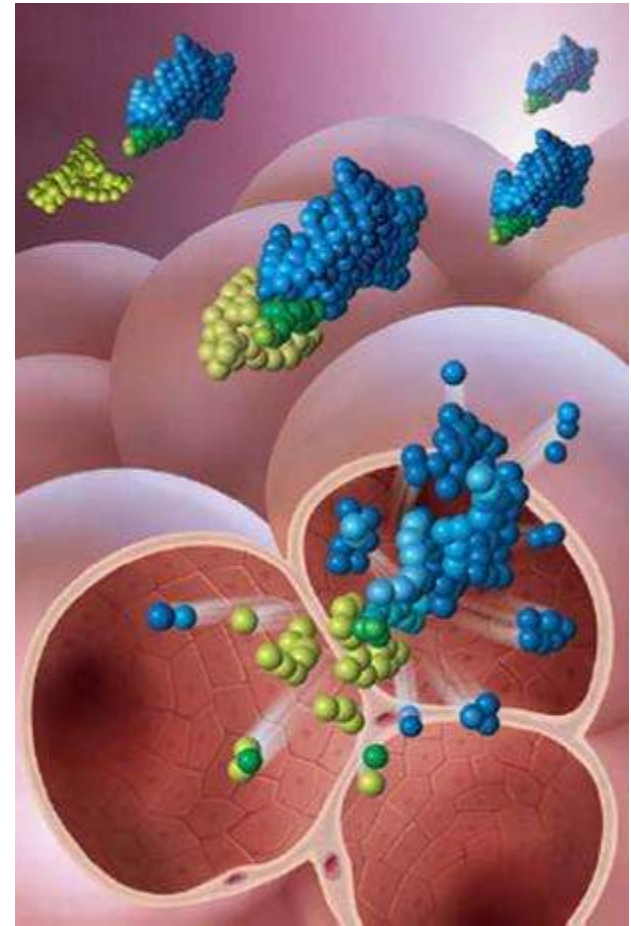
Laboratory methods for evaluating of the patient status: blood tests

- A complete blood count
- Basic chemistry profile
- Serum electrolytes
- C-reactive protein level
- Alpha-1 antitrypsin (AAT) test



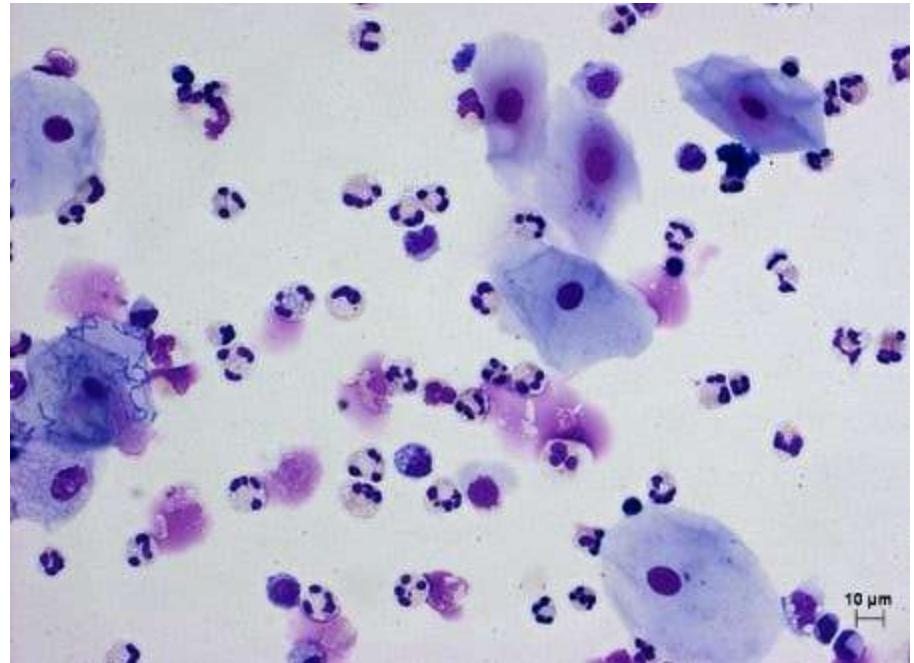
Laboratory methods for evaluating of the patient status: alpha-1 antitrypsin (AAT) test

- People whose bodies do not produce enough of AAT (AAT deficiency) are more likely to develop emphysema and to do so at a younger-than-normal age (30 to 40 years old)
- AAT deficiency is a rare disorder and is the only known genetic factor that increases risk of developing COPD



Laboratory methods for evaluating of the patient status: sputum analysis

- Sputum often consists of bacteria, cellular fragments, blood, and pus
- A sample of sputum can give useful information for screening or diagnosing bacterial infections, non infectious, noncancerous and cancerous conditions in the respiratory system

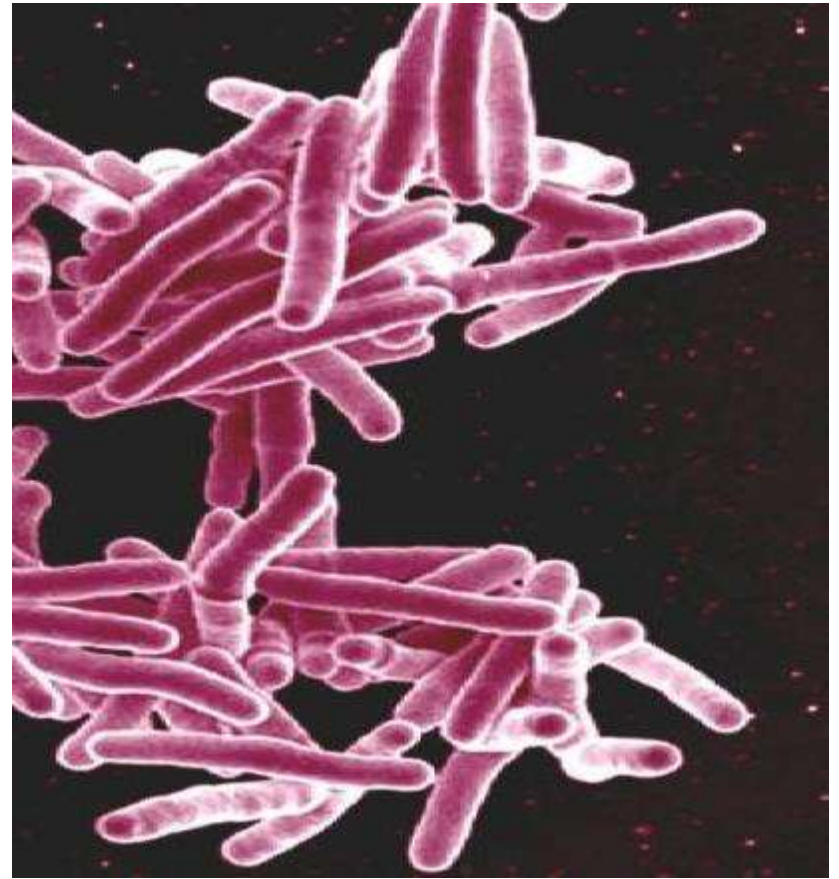
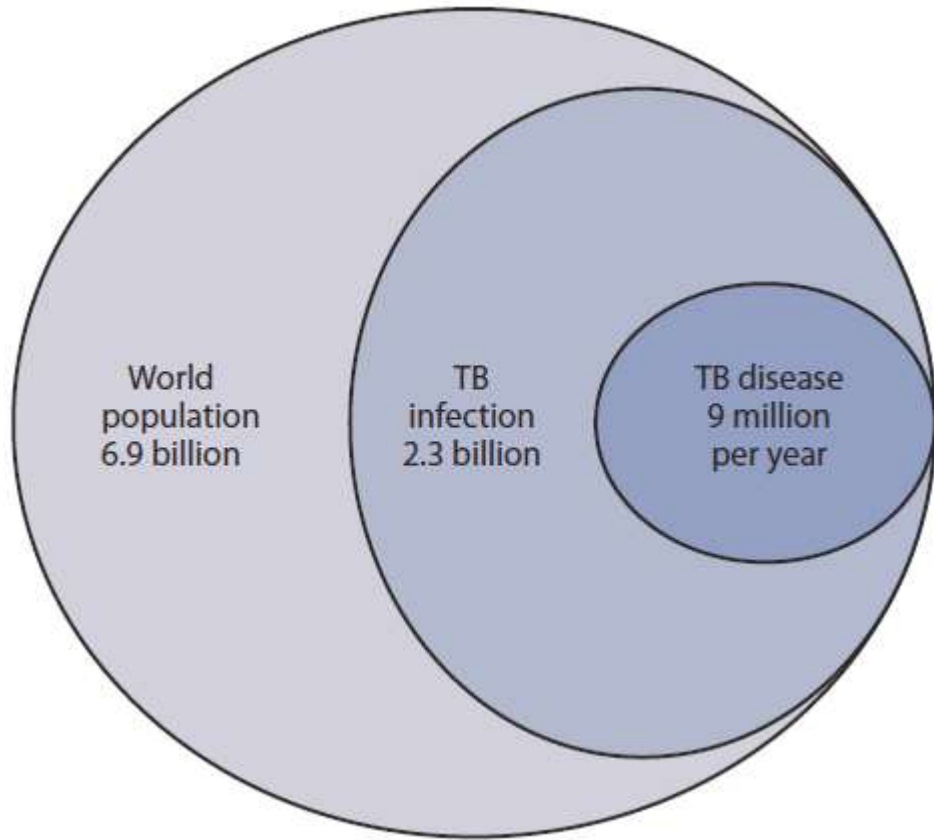


Cells in sputum

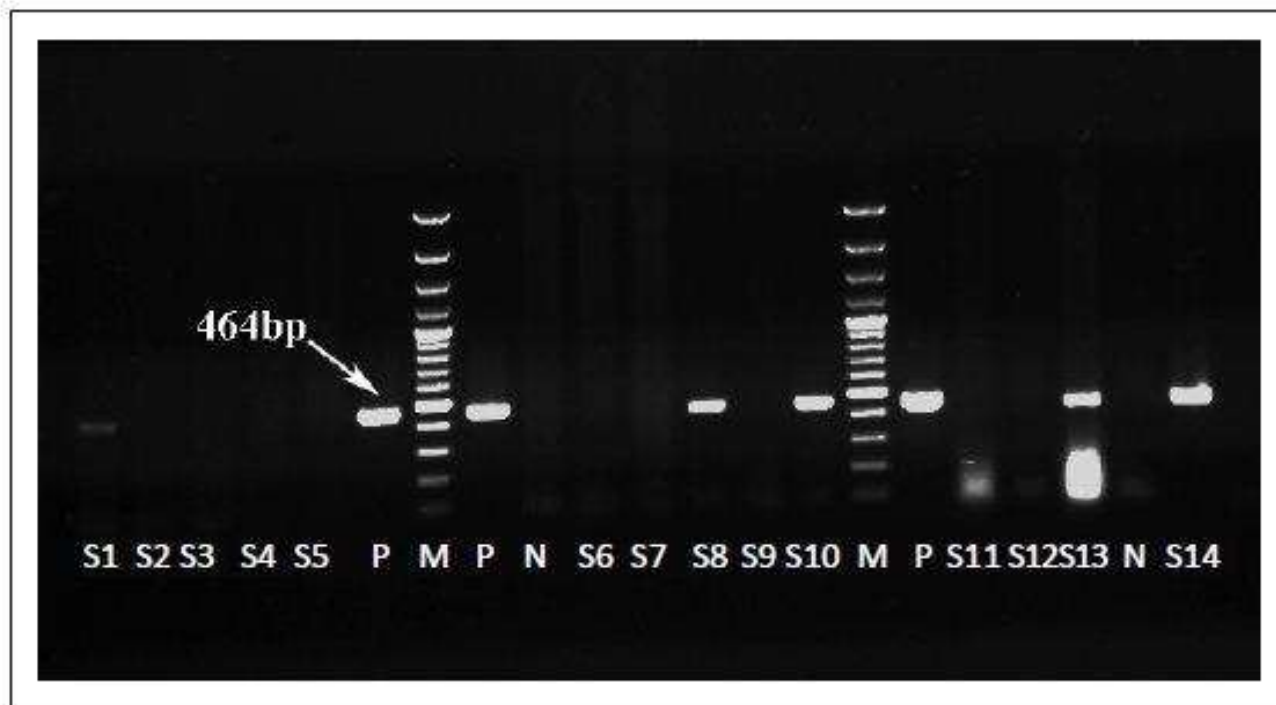
Laboratory methods for evaluating of the patient status: microbiology

- For people that do not respond to treatment, sputum culture should be considered, and culture for *Mycobacterium tuberculosis* should be carried out in persons with a chronic productive cough
- Testing for other specific organisms may be recommended during outbreaks, for public health reasons
- In those hospitalized for severe disease, both sputum and blood cultures are recommended, as well as testing the urine for antigens to *Legionella* and *Streptococcus*
- Viral infections can be confirmed via detection of either the virus or its antigens with culture or polymerase chain reaction (PCR), among other techniques
- The causative agent is determined in only 15% of cases with routine microbiological tests

Laboratory methods for evaluating of the patient status: *Mycobacterium tuberculosis*



Laboratory methods for evaluating of the patient status: polymerase chain reaction



M, Marker 100 bp, N, Negative control, P, Positive control.

S1 and S8, trachea; S2 and S9, lungs; S3 and S10, caecal tonsils; S4 and S11, kidney; S5 and S12, spleen; S13, bursa of Fabricius; S6, thymus; S7 and S14, cloaca.

Detection of infectious bronchitis virus by Reverse transcription polymerase chain reaction in different tissue samples

Lecture 4

Approach to the patient with disease
of the cardiovascular system

Plan of the lecture

Approach to the Patient with Disease of the Cardiovascular System

- Interviewing of the patient
- Physical examination of the patient
- Instrumental methods
- laboratory methods

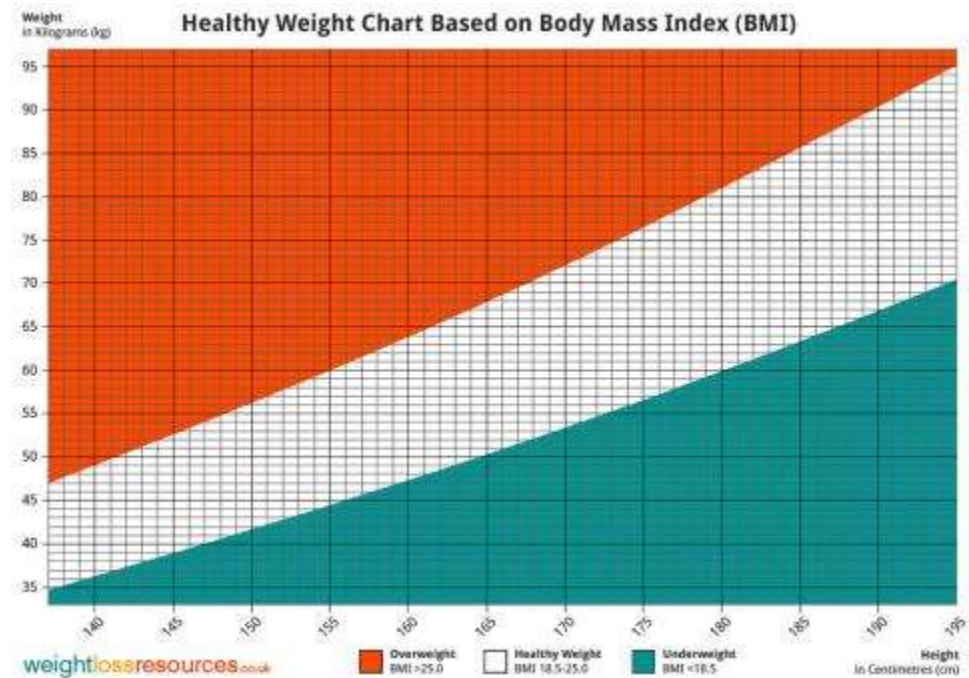
Interviewing of the patient: good questions to get started on the core interview

- What is your chief complaint?
- Tell me why you're here today
- Tell me about your injury
- What can I do to help you?
- Explain to me your understanding of your injury



Interviewing of the patient: patient profile

- Age
- Sex
- Race/Ethnicity
- Handedness
- Ht-Wt-BMI-Body type
- Primary language
- Barriers to learning
- Learning preference
- Unique rehabilitation goals



Interviewing of the patient: chief complaint

- The medical evaluation of chief complaint of a person with suspected heart disease begins with an interview about the patient's major (chief) complaint
- The process begins from asking specific questions about the complaint
- Very often the patient's chief complaint is the chest pain



Interviewing of the patient: chief complaint

Pain (Chest)	Cardiac	Pleuritic	Traumatic
D Description: <ul style="list-style-type: none"> • Can you describe the pain to me? (You need to determine it's nature.) • Is it there all the time? Does it come and go? • Have you ever had this pain before? • What was it that time? 	<ul style="list-style-type: none"> • Heavy • Tight • Squeezing • Dull 	<ul style="list-style-type: none"> • Sharp • Catching • Stabbing 	<ul style="list-style-type: none"> • Sharp • Catching • Stabbing
O Onset: <ul style="list-style-type: none"> • When did it start? • What were you doing at the time? • Did it come only suddenly or slowly? 	<ul style="list-style-type: none"> • Gradual (Angina) • Sudden (UA/Infarct) • With Exercise (Angina) • At Rest (UA/Infarct) 	<ul style="list-style-type: none"> • Gradual (Infection) • Sudden (Pneumothorax) 	<ul style="list-style-type: none"> • Gradual (post trauma) • Sudden (post trauma)
L Location: <ul style="list-style-type: none"> • "Take one finger and point to the pain?" • "Does it extend anywhere else?" • If well localized palpate and visualize 	<ul style="list-style-type: none"> • Poorly localised • Chest to back to jaw • Rarely changes with palpation 	<ul style="list-style-type: none"> • Well localised • Usually chest wall • Usually changes with palpation / ventilation 	<ul style="list-style-type: none"> • Well defined • Usually chest wall • Changes with palpation / ventilation
O Other Signs and Symptoms: <ul style="list-style-type: none"> • "Do you feel nauseous?" • (If yes) "Have you vomited?" • "Do you feel SOB?" • "Have you noticed palpitations?" • "What came first, the discomfort or the (SOB)?" 	<ul style="list-style-type: none"> • SOB 4% • Diaphoresis 4% • Palpitations 4% 	<ul style="list-style-type: none"> • SOB (on exertion) • Chest infection (prodromal) 	<ul style="list-style-type: none"> • SOB (on exertion)
R Relief: <ul style="list-style-type: none"> • "Have you taken anything for the discomfort?" • (If yes) "Has it helped?" • "Does it usually?" • "Does taking a deep breath make the pain better, worse or no different?" • "Does moving make the pain better, worse or no different?" 	<ul style="list-style-type: none"> • Relieved with Nitrates (Angina) • Unrelieved with Nitrates (UA/Infarct) • Poor relief with NSAIDS • Poor relief with position 	<ul style="list-style-type: none"> • Unrelieved with Nitrates • Mild relief with NSAIDS • Some relief with position 	<ul style="list-style-type: none"> • Unrelieved with Nitrates • Mild relief with NSAIDS • Some relief with position

Types of chest pain

Interviewing of the patient: other chief complaints

- Shortness of breath
- Dizziness
- Blackout spells
- Palpitations (a sensation of skipped, forceful, or fast heartbeats)
- Weakness
- Swelling of the legs
- etc.



Interviewing of the patient: specific questions for set of chief complaints

Each of chief complaints will prompt a series of specific questions that will help arrive at a preliminary single diagnosis, or a group of different diagnoses



Interviewing of the patient: example of specific questions in chief complaint' chest pain

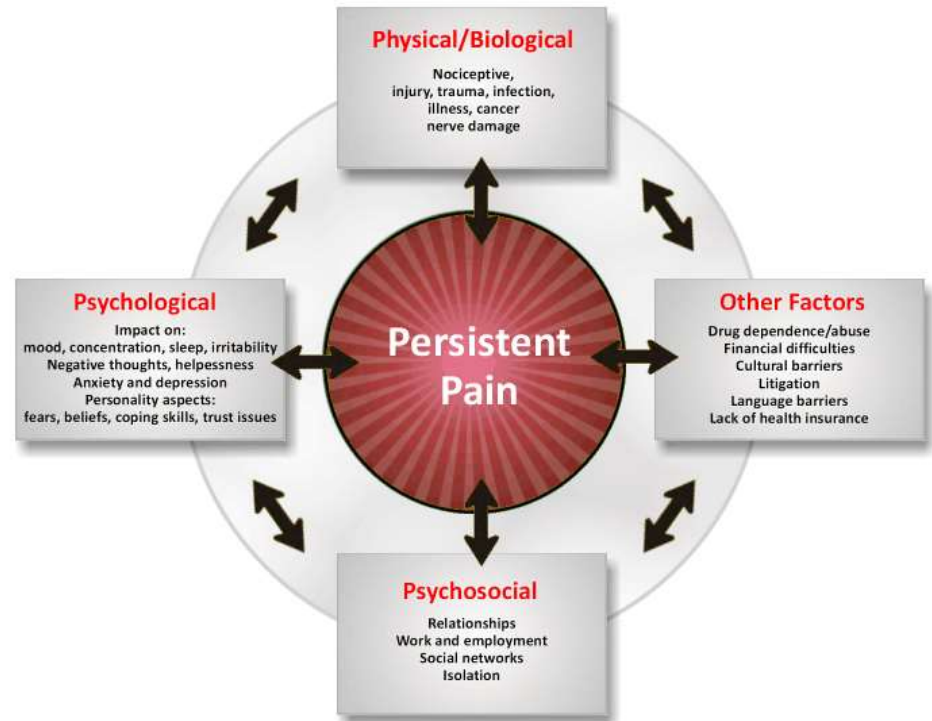
- Character
- Location
- Severity
- Timing
- Duration
- Radiation (shoulder, arms, jaw, back or other parts of the body)
- Provocation
- Relieving conditions
- When did it first start?
- How often does it occur?
- What brought it on?
- Were there associated symptoms (shortness of breath, sweating, dizziness, weakness, nausea, vomiting, etc.)?
- Is it becoming more frequent with time?
- Are the symptoms lasting longer?
- Do they appear at rest or has it awakened the patient from a sound sleep?

Interviewing of the patient: quality of chest pain

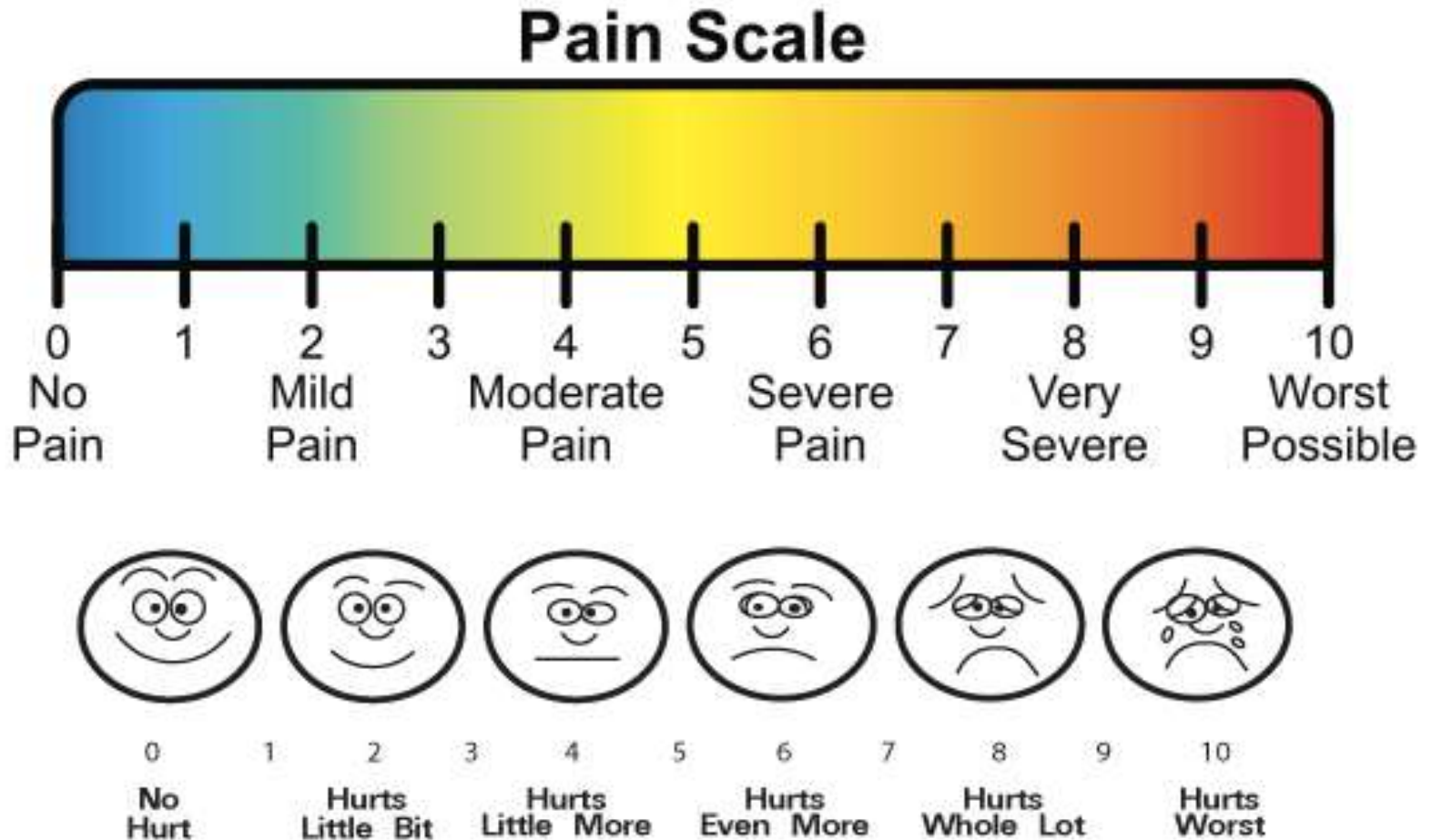
- Squeezing - A band-like sensation is felt around the chest
- Tightness - There is a sensation of a knot being present in the center of the chest
- Pressure - A sensation of a lump in throat or a heavy weight on the chest
- Chest Constriction - The “Levine sign” is displayed by a patient suffering from chest pain caused by a myocardial infarction
- The patient typically presses a clenched fist against the chest to illustrate the sensation of pressure and constriction in the chest
- Burning - Infarction pain is often mistaken for heartburn or indigestion, especially in women.

Interviewing of the patient: factors that influence pain

- Physical stress
- Cold
- Emotional stress
- Sexual intercourse
- Smoking
- Meals
- Sleeping problems



Interviewing of the patient: Visual Analog and Numerical Pain Rating Scales



Interviewing of the patient: list of possible complaints

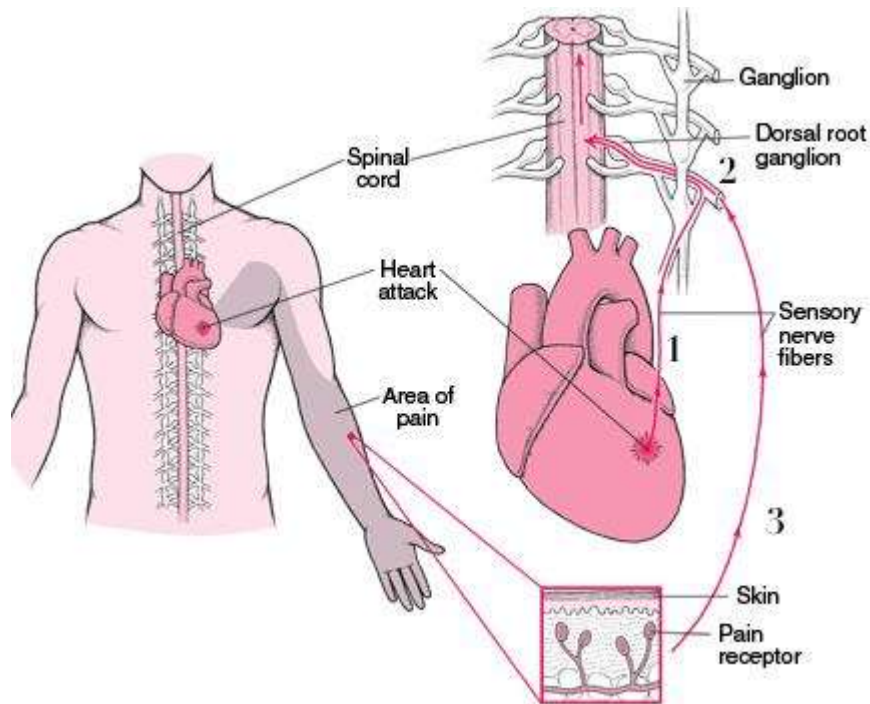
More specific

- Pain in the heart region
- Palpitation
- Dyspnea
- Cardiac asthma
- Cough
- Hemoptysis
- Edema
- Syncope
- Irritability
- Numbness/tingling
- Skin changes
- Leg swelling

More nonspecific

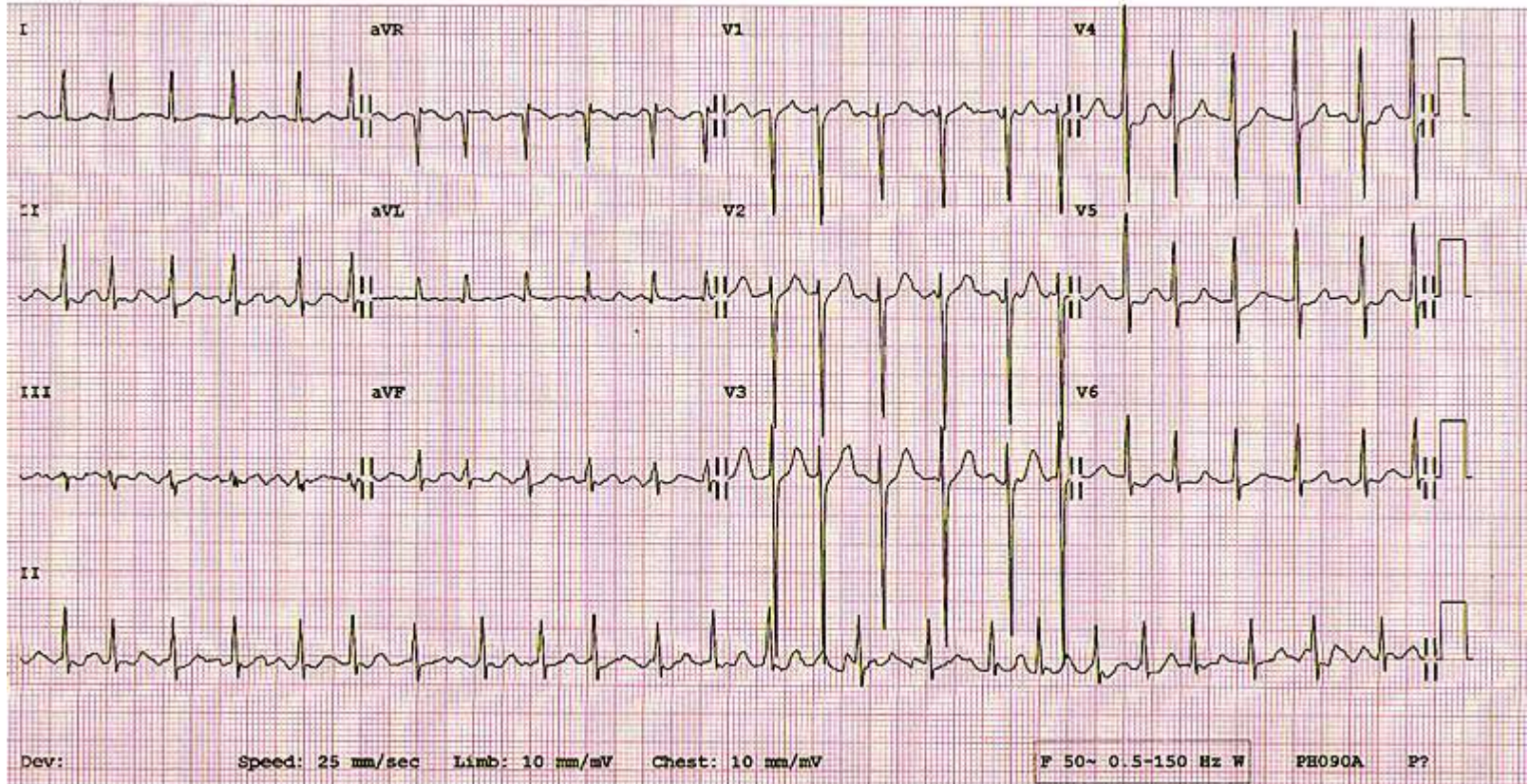
- Fever
- Sweatiness
- Weight loss
- Fatigue
- Headache
- Dizziness
- Sleeplessness
- Deranged vision and hearing
- Voice changes
- Dysphagia
- Dyspepsia
- Thirst
- Pain in the abdomen
- Pain in the joints

Interviewing of the patient: pain in the heart region



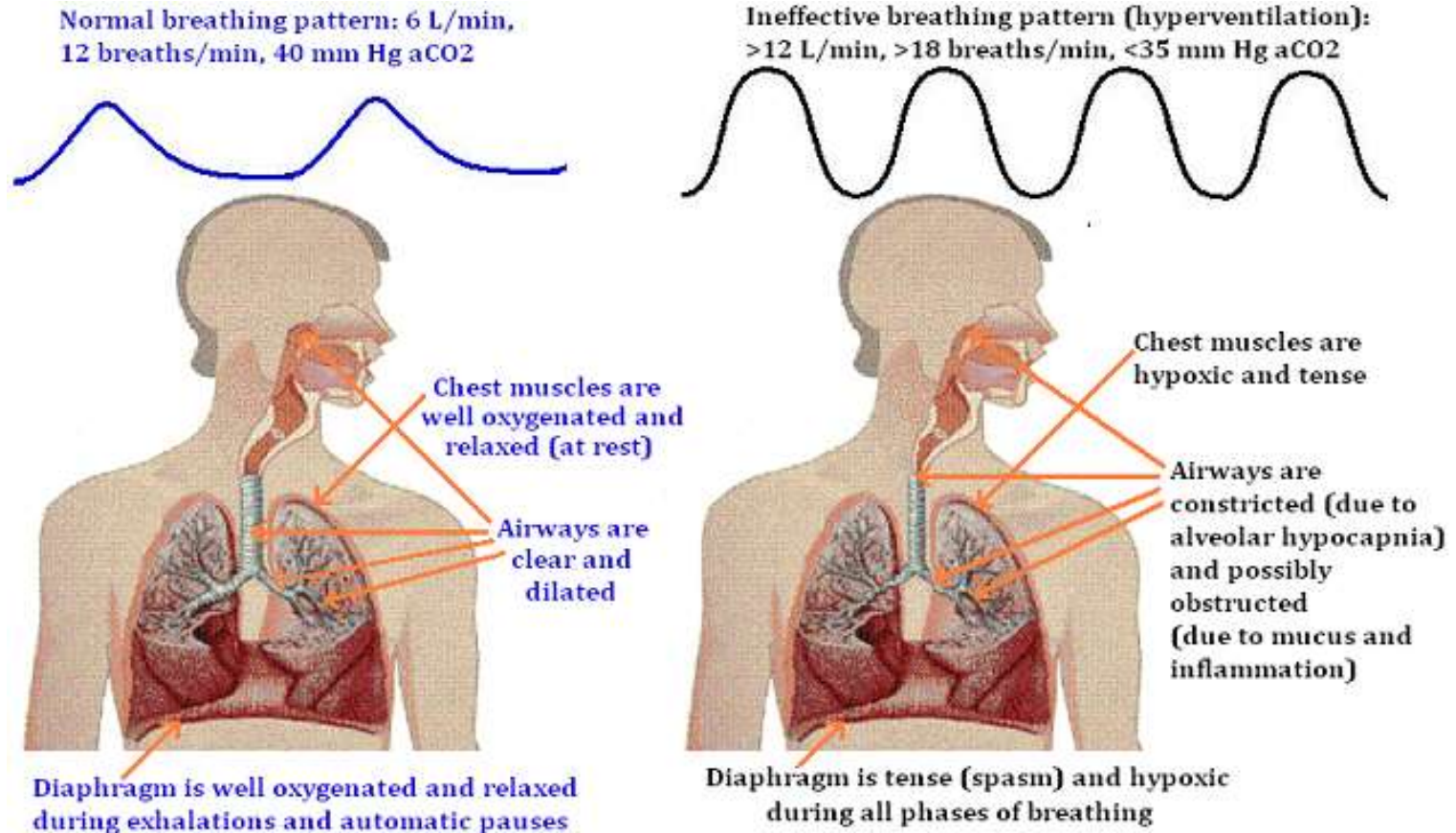
Pain or discomfort that occurs in an area of heart muscle

Interviewing of the patient: palpitation



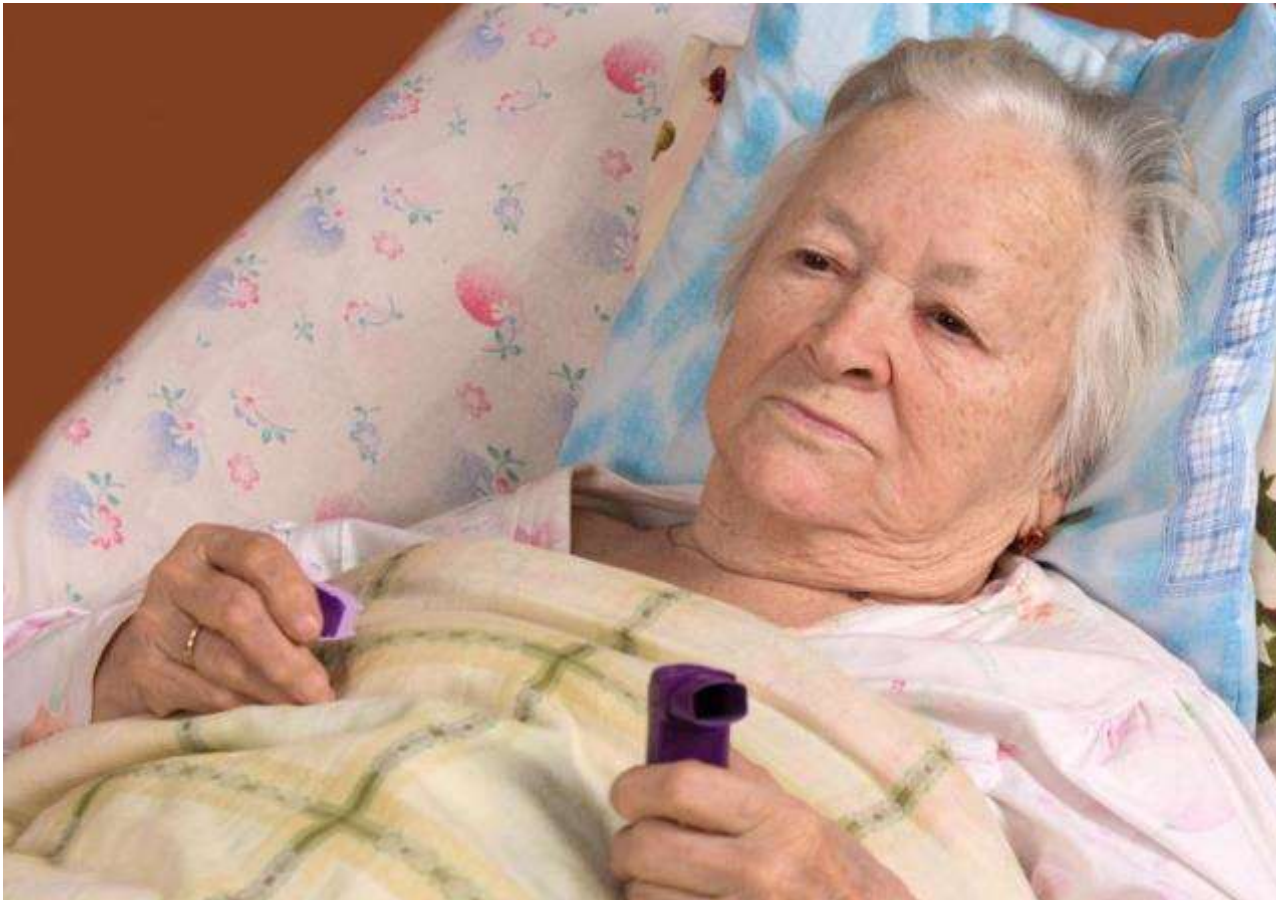
The feelings of having rapid, fluttering or pounding heart.

Interviewing of the patient: dyspnea



The sensation of difficult or uncomfortable breathing

Interviewing of the patient: dyspnea



Wheezing, coughing or shortness of breath due to congestive heart failure

Interviewing of the patient: cardiac asthma



Breathing difficulty associated with congestive heart failure

Interviewing of the patient: cough



Persistent coughing can be a symptom of heart failure

Interviewing of the patient: hemoptysis



- Hemoptysis is the act of coughing up blood or blood-stained mucus from the bronchi, larynx, trachea, or lungs
- The most common of these is left ventricular systolic heart failure

Interviewing of the patient: edema



Cardiogenic edema an accumulation of serum fluid from blood plasma in the interstitial tissues as a result of congestive heart failure

Interviewing of the patient: syncope



A short loss of consciousness and muscle strength, characterized by a fast onset, short duration, and spontaneous recovery

Interviewing of the patient: irritability



An excitation response to stimuli

Interviewing of the patient: numbness/tingling



Numbness and tingling are unusual prickling sensations that can happen in any part of human body, but they are generally noticed in hands, feet, arms, and legs

Interviewing of the patient: skin changes

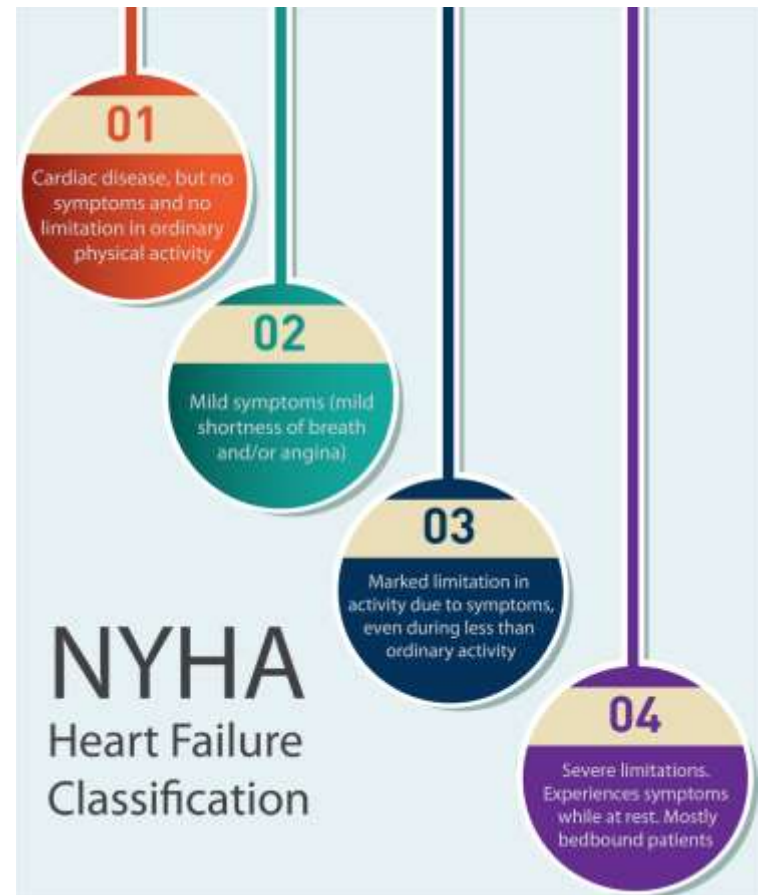


Cyanosis

Symptoms caused by heart failure

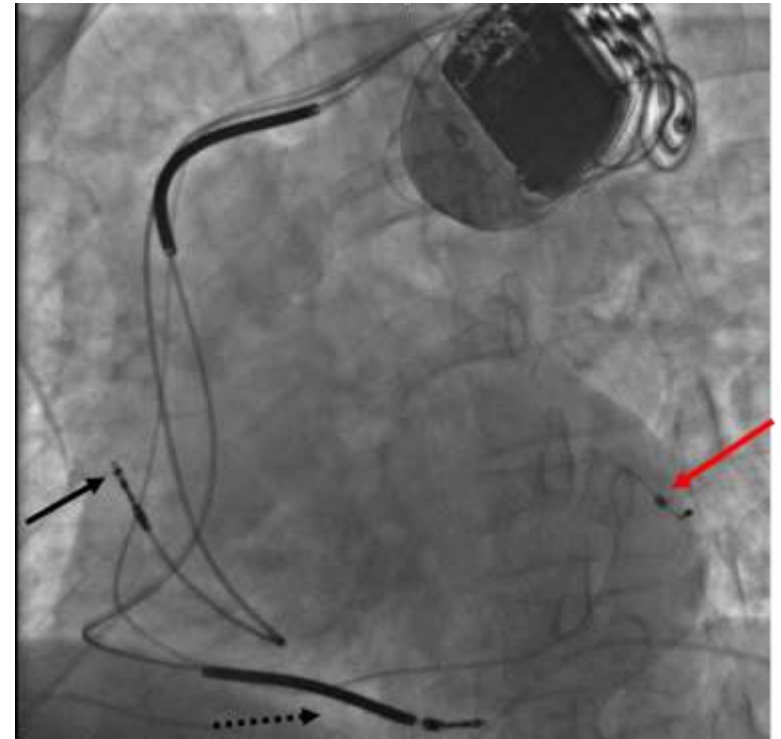
Interviewing of the patient: past medical history

The past medical history will include questions about conditions such as diabetes, high blood pressure, elevated cholesterol levels, prior surgery, asthma, stroke, cancer, allergies, etc.



Interviewing of the patient: prior or current treatment

- Medications
- Cardiac surgery
- Injections
- Chiropractic
- Exercise/PT (Physical Therapy)
- ER (Emergency Room)
- Massage therapy



Interviewing of the patient: previous treatment and present status

- Previous Treatment
 - What?
 - Where?
 - When?
 - By whom?
- Present Status
 - Better vs. same vs. worse



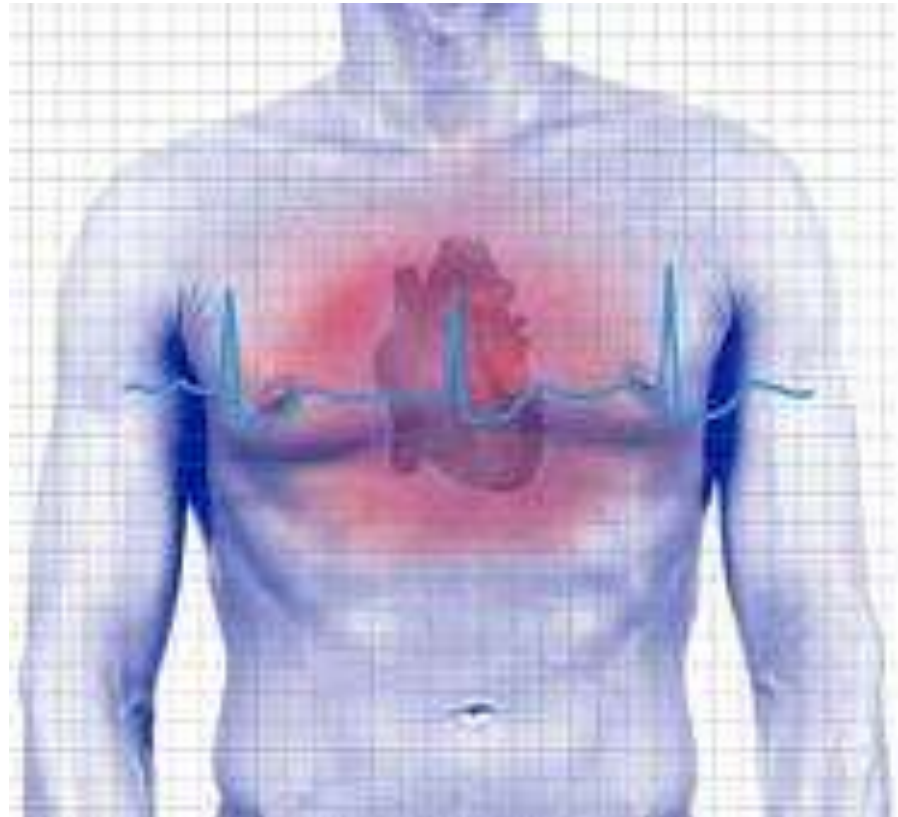
Interviewing of the patient: family history

- Certain cardiac illnesses may occur in more than one member of a family
- The physician will inquire about the health of the patient's parents, brothers, sisters and children



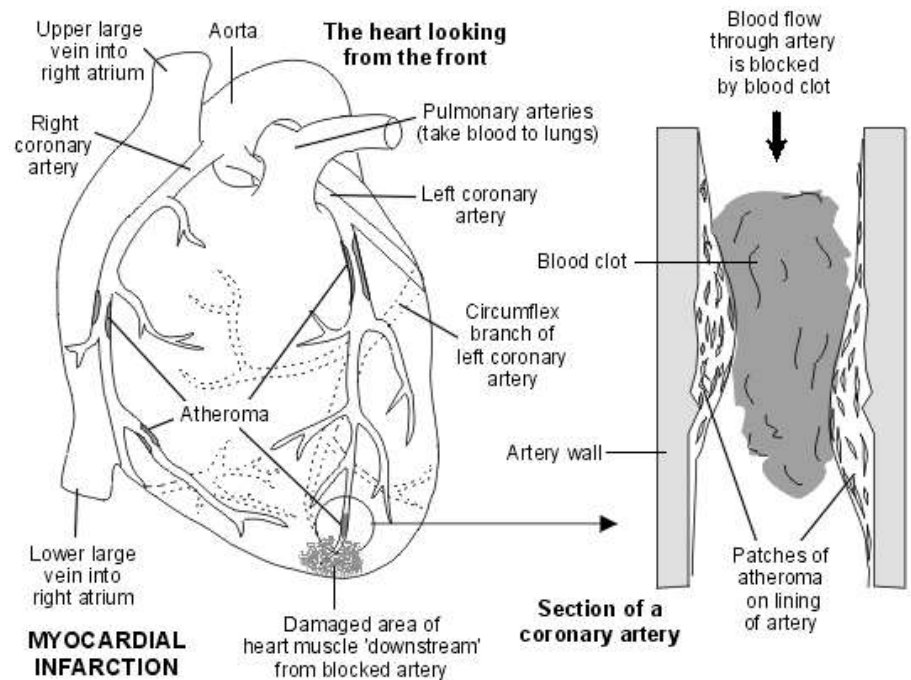
Interviewing of the patient: social history

- High-risk behaviors
 - Alcohol, tobacco, or drug abuse
 - Depression
 - Violence/abuse
 - Diet
 - Anorexia/bulimia
 - Sedentary lifestyle
- Signs of any of the above behaviors may warrant referral to a secondary provider



Interviewing of the patient: why take a medical history?

- Up 90% of conditions can be accurately diagnosed or recognized by conducting a thorough medical history and listening carefully to the patient's response(s)
- Determines the necessary tests and measures you should prioritize for your objective examination



Interviewing of the patient: review of systems

- The "laundry list" of symptoms related to various organs of the body
- A series of questions helps seek out information that the patient may have neglected to provide the physician
- Review of systems helps to identify the patient's problem, or exclude different parts of the differential diagnosis



Interviewing of the patient: systemic enquiry

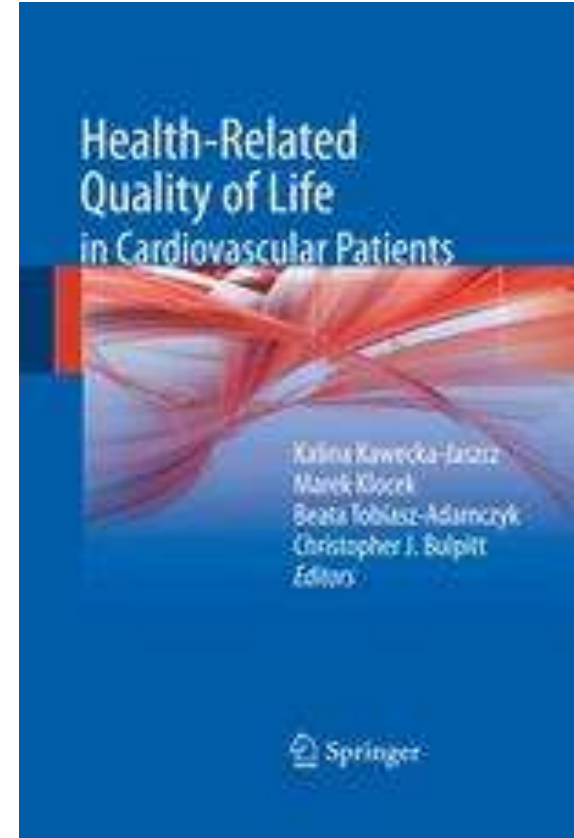
- General: fever, weight loss, loss of appetite, lethargy
- Respiratory system: shortness of breath, cough, hemoptysis, wheeze, chest pain
- Gastrointestinal system: nausea and vomiting, hematemesis, dysphagia, heartburn, jaundice, abdominal pain, change in bowel habit, rectal bleeding, tenesmus (sensation of incomplete bowel emptying)
- Genito-urinary system: dysuria (pain on passing urine), frequency, terminal dribbling, urethral discharge
- Gynecological system: pelvic pain, vaginal bleeding, vaginal discharge, LMP
- Neurological system: headaches, dizziness, loss of consciousness, fits, faints, funny turns, numbness, tingling, weakness, problems speaking, change in vision

Interviewing of the patient: short form-36 (SF-36)

- The Short Form-36 (SF-36) is a 36 item questionnaire which measures Quality of Life (QoL) across eight domains, which are both physically and emotionally based
- The eight domains are as follows: physical functioning; role limitations due to physical health; role limitations due to emotional problems; energy/fatigue; emotional well-being; social functioning; pain; general health
- A single item is also included that identifies perceived change in health, making the SF-36 a useful indicator for change in QoL over time and treatment

Interviewing of the patient: functional status

- Quality of Life Scales
 - The Short Form-36 ([SF36](#))
 - Sickness Impact Profile Sickness Impact Profile
- Region Specific Disability Indices
 - [DASH \(Disabilities of Arm-Shoulder-Hand\)](#)
 - Oswestry Pain Indices (Neck or Back)
 - LEFS – Lower Extremity Functional Scale
- Disease Specific Scales



Physical examination of the patient: positioning

- The patient is positioned in the supine position tilted up at 45 degrees if can tolerate this
- The level of the jugular venous pressure (JVP) should only be commented on in this position as flatter or steeper angles lead to artificially elevated or reduced level respectively
- Lighting should be adjusted so that it is not obscured by the examiner who will approach from the right hand side of the patient as is medical custom



Physical examination of the patient: general inspection

- Inspect the patient status whether he or she is comfortable at rest or obviously short of breath
- Inspect the neck for increased jugular venous pressure (JVP) or abnormal waves
- Any abnormal movements such as head bobbing
- There are specific signs associated with cardiac illness and abnormality however, during inspection any noticed cutaneous sign should be noted

Physical examination of the patient: hands inspection

- Temperature (warm, cool, clammy, dry)
- Skin turgor for hydration
- Janeway lesion (infective endocarditis)
- Osler's node (painful, red, raised lesions found on the hands and feet, are caused by immune complex deposition)
- Splinter hemorrhage, Quincke's pulsation, any deformity of the nail (Beau's lines, clubbing), peripheral cyanosis

Physical examination of the patient: head inspection

- The malar flush of mitral stenosis
- The eyes for corneal arcus and surrounding tissue for xanthlasma
- Conjunctiva pallor a sign of anemia
- The mouth for hygiene
- The mucosa for hydration and pallor or central cyanosis
- The ear lobes for Frank's sign



Normal ear lobe



Ear lobe crease

Physical examination of the patient: precordial inspection

- Visible pulsations
- Apex beat
- Masses
- Scars
- Lesions
- Signs of trauma and previous surgery
- Permanent Pacemaker
- Precordial bulge



Physical examination of the patient: pulses (radial, brachial, carotid) palpation

- Rate
- Rhythm
- Pulse pressure -требуется измерения АД
- Regularity (regular, regularly irregular, irregularly irregular)
- Consistency of the strength to assess for pulsus alternans
- Slow rising (parvus, tardus)
- Jerky (hypertrophic cardiomyopathy)
- Traube's pistol shot femoral pulse



Physical examination of the patient: precordial palpation

- The valve areas are palpated for abnormal pulsations (palpable heart murmurs known as *thrills*) and precordial movements (known as *heaves*)
- The apex beat is found approximately in the 5th left intercostal space in the mid-clavicular line
 - The apex beat can be impalpable for a variety of reasons including obesity, emphysema, effusion and rarely dextrocardia
 - The apex beat is assessed for size, amplitude, location, impulse and duration
 - There are specific terms to describe the sensation such as tapping, heaving and thrusting

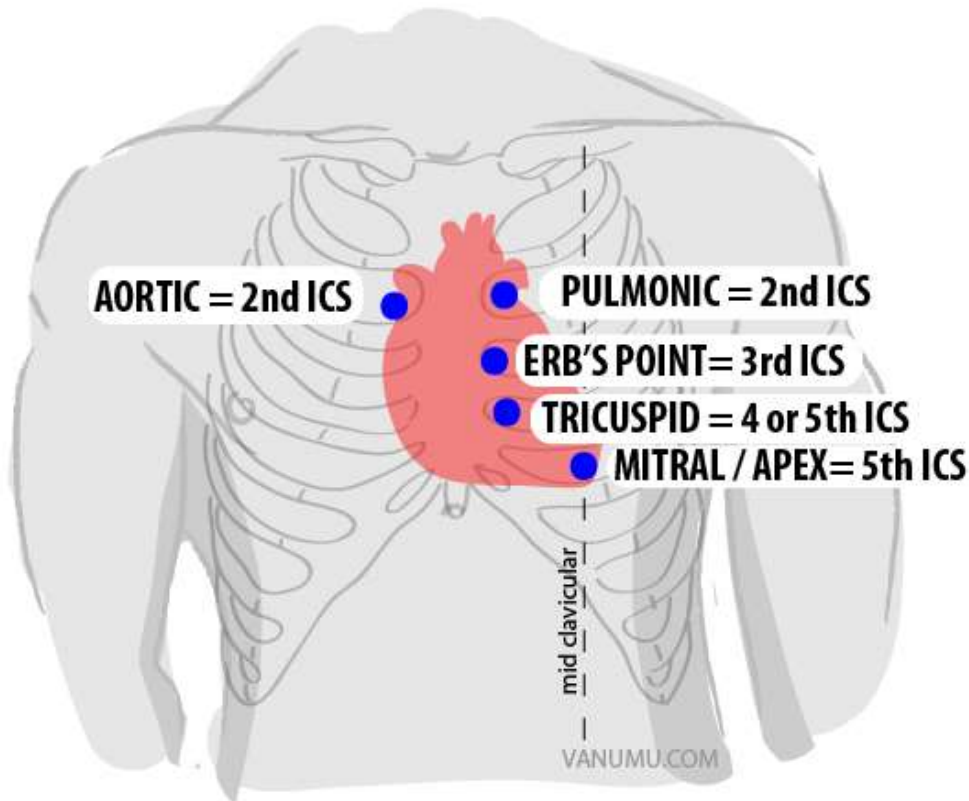
Physical examination of the patient: cardiac percussion: a lost art?

- There was a time when cardiac percussion was considered a useful addition in the clinical evaluation of the patient with heart disease
- This skill has been largely lost with the advent of new imaging techniques such as X-ray and echocardiography, both of which are more accurate in defining cardiac size and borders and detecting the presence and extent of pericardial fluid
- When used in isolation, cardiac percussion is prone to error but when used in clinical context with other findings, it could still be an invaluable bedside tool in differentiating tamponade from acute massive pulmonary embolism until confirmation with echocardiography

Physical examination of the patient: heart auscultation

- Auscultation is usually performed with the patient sitting up or reclined at about 45°
- Sites for auscultation
 - Mitral valve area: at the apex beat, as the left ventricle is closest to the thoracic cage
 - Tricuspid valve area: inferior right sternal margin is the point closest to the valve in which auscultation is possible
 - Pulmonary artery valve area: left second intercostal space close to the sternum is where the infundibulum is closest to the thoracic cage
 - Aortic valve area: right second intercostal space close to the sternum is where the ascending aorta is nearest to the thoracic cage
- The best place to hear the heart valves is not necessarily directly over the anatomical site

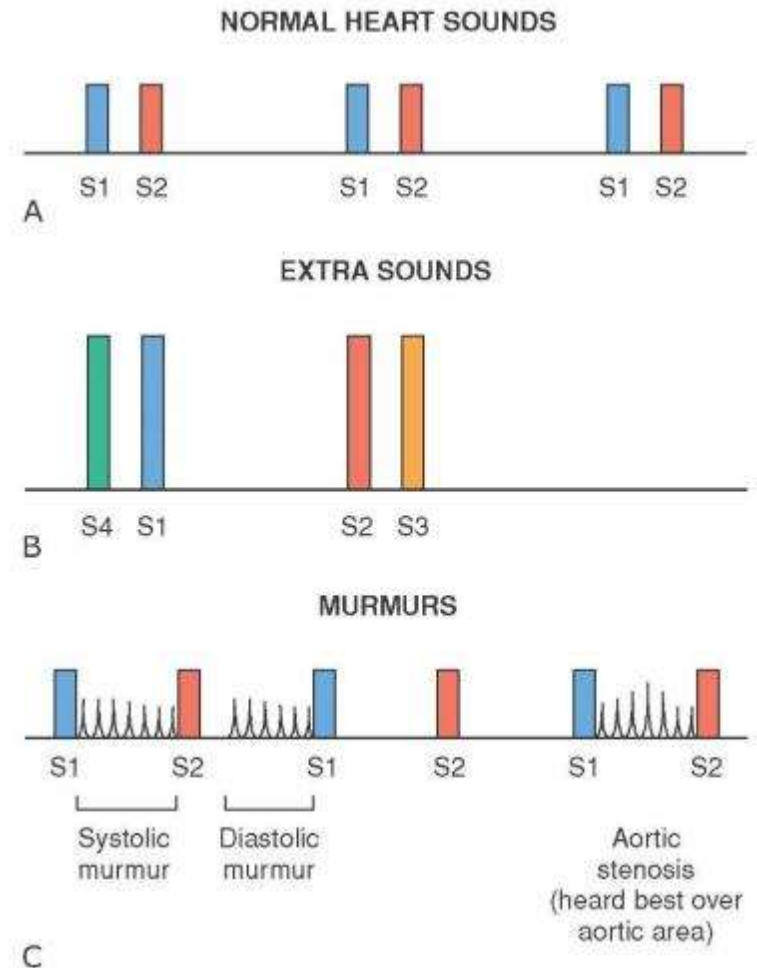
Physical examination of the patient: sites of the heart auscultation



- All People Eat Turkey Meat is the mnemonic I was taught to remember the points of auscultation of the heart
- All = Aortic
- People = Pulmonic
- Eat = Erb's Point
- Turkey = Tricuspid
- Meat = Mitral

Physical examination of the patient: normal heart sounds in auscultation

- Normal heart sounds are the noises generated by the beating heart and the resultant flow of blood through it, the sounds reflect the turbulence created when the heart valves snap shut
- In healthy adults, there are two normal heart sounds (a lub and a dub (or dup)), that occur in sequence with each heartbeat
- These are the first heart sound (S_1) and the second heart sound (S_2), produced by the closing of the atrioventricular valves and semilunar valves

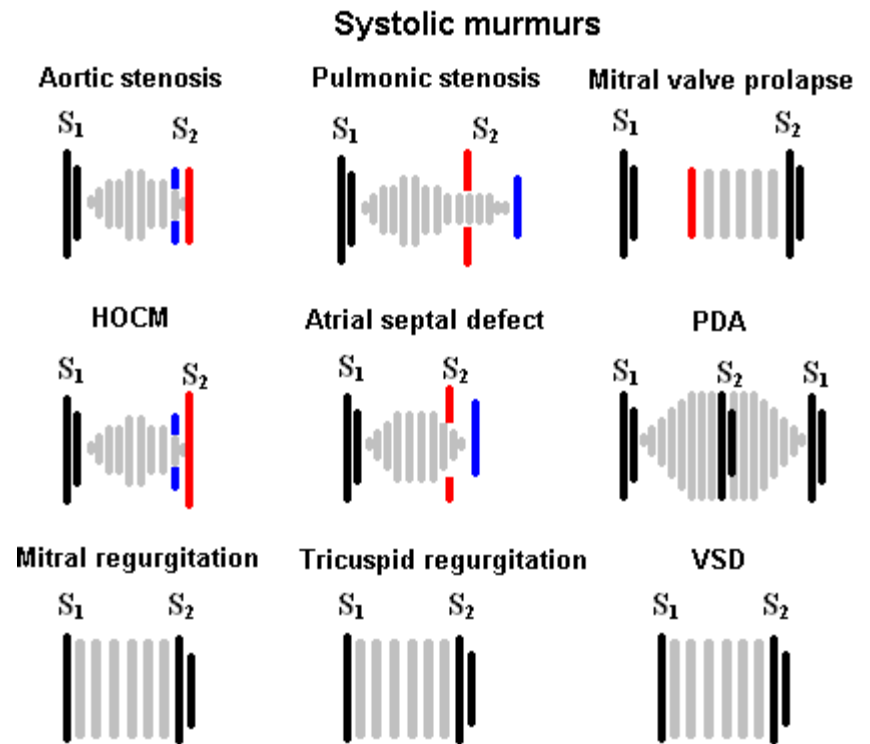


Physical examination of the patient: changes of normal heart sounds in auscultation

- The first sound may be split if there is pacing that triggers the right ventricle before the left or if mitral valve closure is delayed by high left atrial pressure or atrial myxoma
- The sounds may be softer than normal where there is severe mitral regurgitation, immobility from calcification, severe aortic regurgitation or left bundle branch block
- Prolapsed mitral valve or significant mitral stenosis may cause a loud M1
- Normally A2 and P2 are so close that they are heard as a single sound although they may split slightly on deep inspiration as P2 is delayed
- Beat to beat variation in the intensity of S2 occurs with complete or incomplete heart block if there is A-V dissociation
- P2 is delayed and will accentuate splitting in pulmonary hypertension, pulmonary stenosis and right bundle branch block
- Ectopic beats and pacing will delay A2 and cause 'reverse splitting' of the sound

Physical examination of the patient: other heart sounds in auscultation

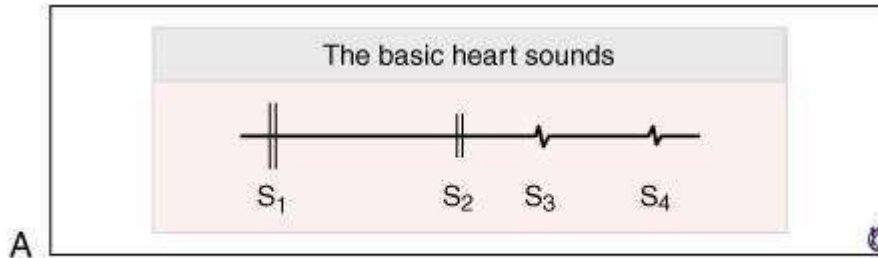
- Heart murmurs
- Adventitious (respiratory atc.) sounds
- Gallop rhythms S_3 and S_4 (may be heard in young or athletic people, ordinary are a signs of serious cardiac problems like heart failure as well as pulmonary edema)



Physical examination of the patient: heart murmurs in auscultation

- Heart murmurs are generated by turbulent blood flow , which may occur inside or outside the heart
- Murmurs may be physiological (benign) or pathological (abnormal)
- Abnormal murmurs can be caused by stenosis restricting the opening of a heart valve, resulting in turbulence as blood flows through it
- Abnormal murmurs may also occur with valvular insufficiency (regurgitation), which allows backflow of blood when the incompetent valve closes with only partial effectiveness
- Different murmurs are audible in different parts of the cardiac cycle, depending on the cause of the murmur

Physical examination of the patient: 3rd & 4th sounds in auscultation



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- A 3rd sound in heart failure produces a cadence like a galloping horse ('gallop rhythm')
- A 4th sound occurs in ventricular hypertrophy, ischaemic heart disease, mitral stenosis, dilated cardiomyopathy, hyperdynamic circulation, arrhythmia, heart block just before the 1st and is an abnormal sound of the A-V valves opening as the atria contract
- An atrial myxoma can 'plop' during atrial systole and cause a late diastolic sound

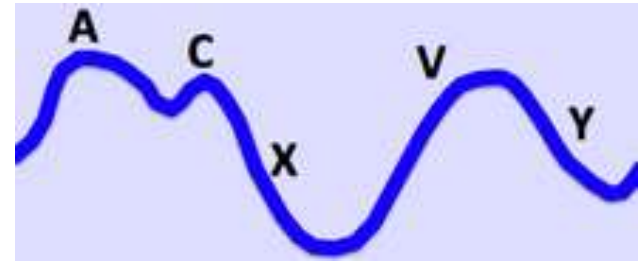
Physical examination of the patient: Levine's scale of heart sounds and murmurs graduation in auscultation

- I - lowest intensity, difficult to hear even by experts
- II - low intensity, but usually audible to all listeners
- III - medium intensity, easy to hear even by inexperienced listeners, but without a palpable thrill
- IV - medium intensity with a palpable thrill
- V - loud intensity with a palpable thrill. Audible even with the stethoscope placed on the chest, with the edge of the diaphragm
- VI - loudest intensity with a palpable thrill. Audible even with the stethoscope raised above the chest

Physical examination of the patient: jugular venous pressure

- The jugular venous pressure (JVP, sometimes referred to as *jugular venous pulse*) is the indirectly observed pressure over the venous system via visualization of the internal jugular vein
- JVP can be useful in the differentiation of different forms of heart and lung disease
- Classically three upward deflections and two downward deflections of the JVP:
 - The upward deflections are the "a" (atrial contraction), "c" (ventricular contraction and resulting bulging of tricuspid into the right atrium during isovolumetric systole) and "v" = atrial venous filling
 - The downward deflections of the wave are the "x" (the atrium relaxes and the tricuspid valve moves downward) and the "y" descent (filling of ventricle after tricuspid opening).

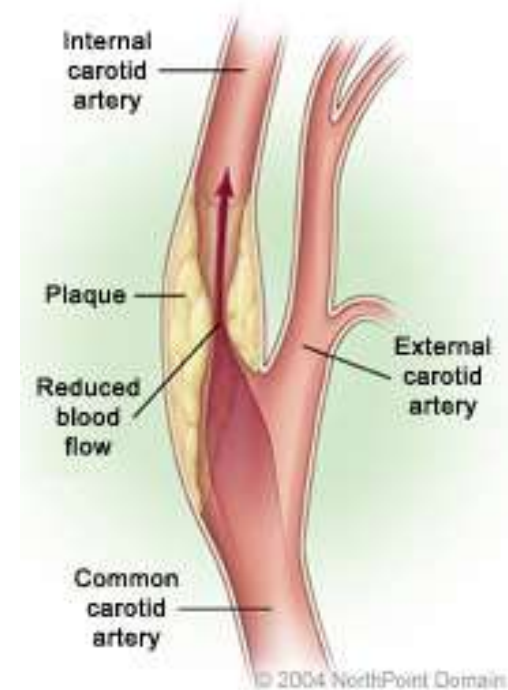
Physical examination of the patient: jugular venous pressure waveform



- The "a" wave corresponds to right **A**trial contraction and ends synchronously with the carotid artery pulse
- The "c" wave corresponds to right ventricular contraction causing the tri**C**uspid valve to bulge towards the right atrium
- The "x" descent follows the 'a' wave and corresponds to atrial rela**X**ation and rapid atrial filling due to low pressure
- The "v" wave corresponds to **V**enous filling when the tricuspid valve is closed and venous pressure increases from venous return - this occurs during and following the carotid pulse
- The "y" descent corresponds to the rapid empt**Y**ing of the atrium into the ventricle following the opening of the tricuspid valve

Physical examination of the patient: carotid bruit

- A carotid bruit is a systolic sound heard over the carotid artery area during auscultation
- Many carotid bruits are discovered incidentally in an otherwise asymptomatic
- Any bruit must be evaluated by ultrasound or imaging patient



Physical examination of the patient: ankle brachial pressure index

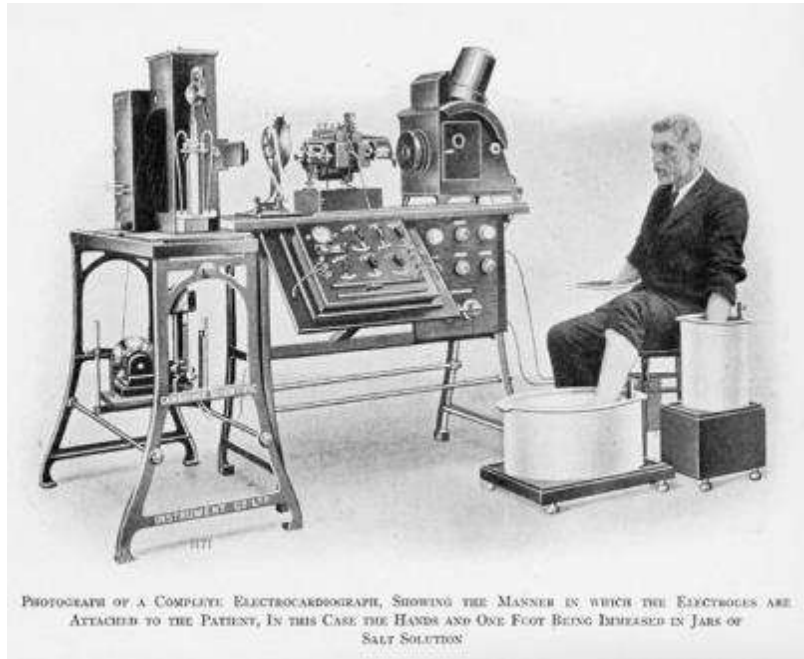
- The ankle brachial pressure index (ABPI or ankle brachial index (ABI) is the ratio of the blood pressure in the lower legs to the blood pressure in the arms. Compared to the arm, lower blood pressure in the leg is an indication of blocked arteries (peripheral artery disease or PAD)
- The ABI is calculated by dividing the systolic blood pressure at the ankle by the systolic blood pressures in the arm

ABI Value	Interpretation	Recommendation
Greater than 1.4	Calcification / Vessel Hardening	Refer to vascular specialist
1.0 - 1.4	Normal	None
0.9 - 1.0	Acceptable	
0.8 - 0.9	Some Arterial Disease	Treat risk factors
0.5 - 0.8	Moderate Arterial Disease	Refer to vascular specialist
Less than 0.5	Severe Arterial Disease	Refer to vascular specialist

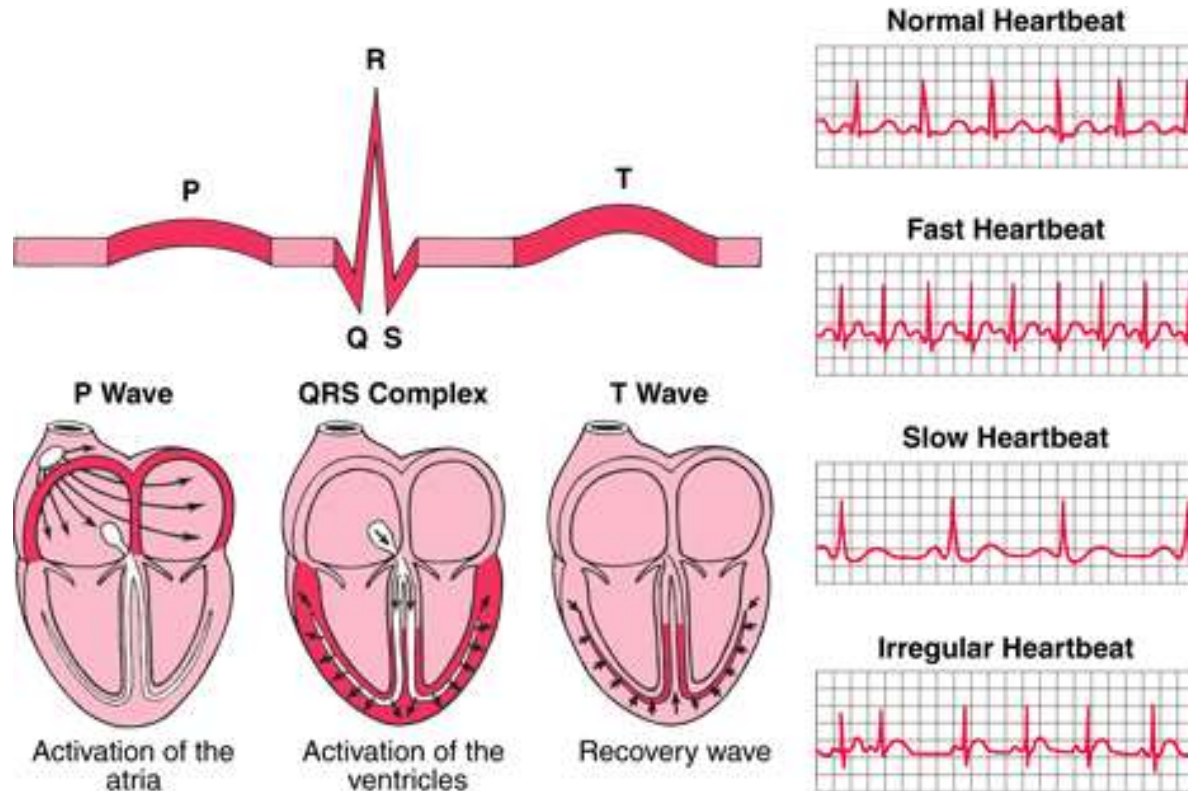
Instrumental methods: electrocardiography (ECG definition & targets)

- ECG is a test that records the electrical activity of the heart
- An ECG is used to measure:
 - Any damage to the heart
 - How fast heart is beating and whether it is beating normally
 - The effects of drugs or devices used to control the heart (such as a pacemaker)
 - The size and position of heart chambers
- The accuracy of the ECG depends on the condition being tested
- A heart problem may not always show up on the ECG
- Some heart conditions never produce any specific ECG changes

Instrumental methods: electrocardiography (devices in historical portrait)



Instrumental methods: electrocardiography (records examples)

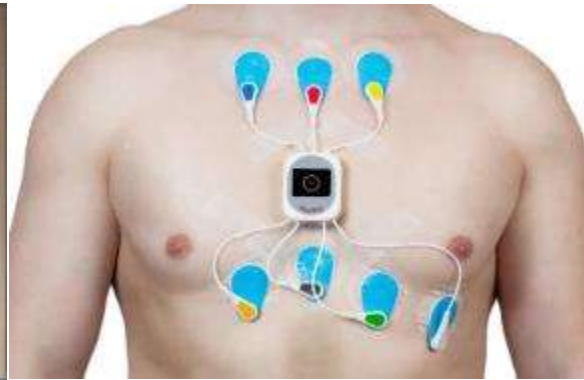


Instrumental methods:

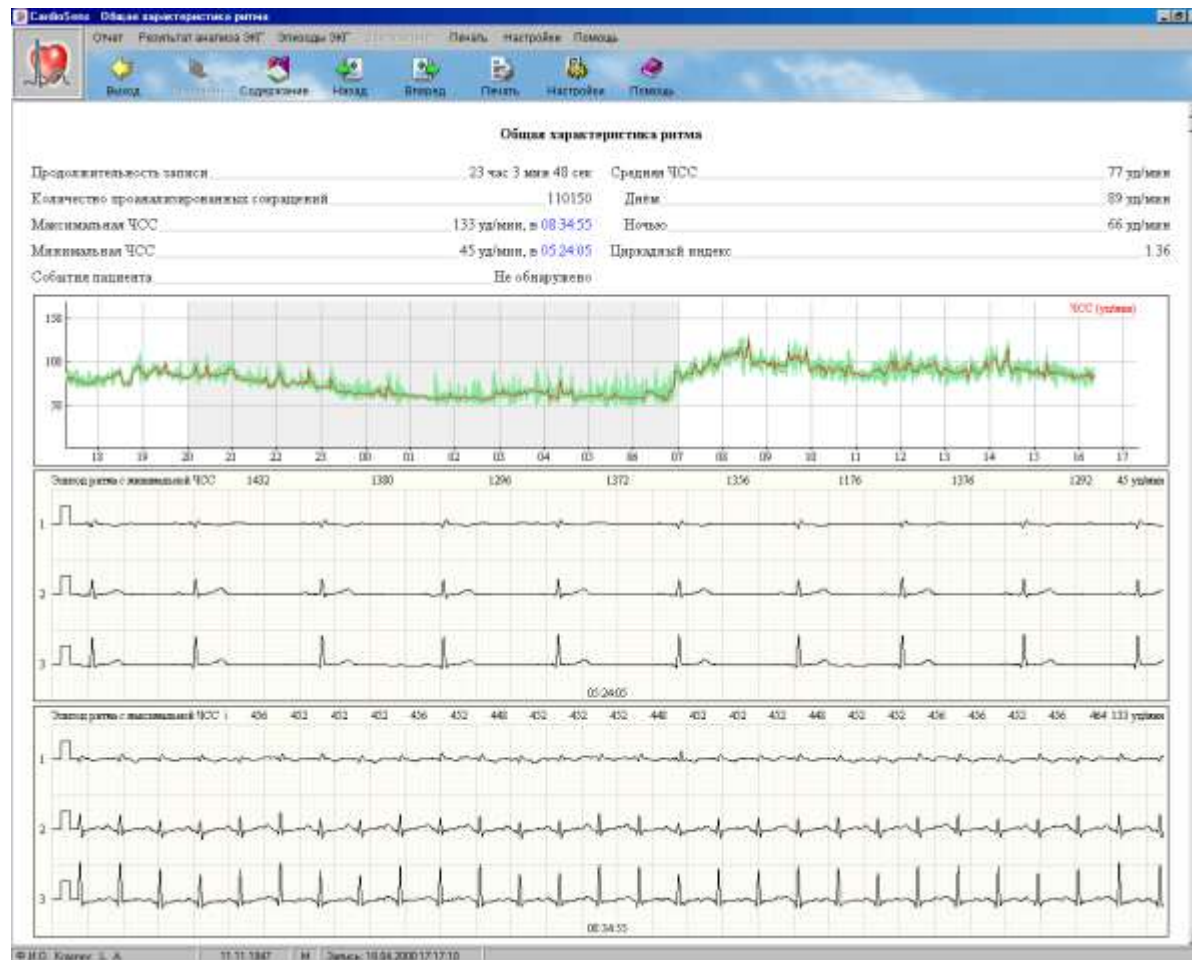
Ambulatory electrocardiogram (Holter Monitor)

- The Holter monitor is a type of ECG used to monitor the ECG tracing continuously for a period of 24 hours or longer
- The Holter monitor used for suspected frequent rhythm abnormalities, especially ones the wearer may not recognize by symptoms:
 - Atrial fibrillation or flutter
 - Multifocal atrial tachycardia
 - Palpitations
 - Paroxysmal supraventricular tachycardia
 - Reasons for fainting
 - Slow heart rate (bradycardia)
 - Ventricular tachycardia
 - Chronomedicine

Instrumental methods: Holter Monitor (devices in historical portrait)



Instrumental methods: Holter Monitor (records examples)



Instrumental methods: Event monitor (definition & targets)

- An Event monitor records short term EKG rhythm patterns, generally storing the last 2 to 5 minutes, adding in new and discarding old data, for 1 to 2 weeks or more
- When the wearer presses a button on the monitor, it quits discarding old and continues recording for a short additional period
- These monitors are used for suspected infrequent rhythm abnormalities, especially ones the wearer does recognize by symptoms

Instrumental methods: Event monitor (devices)



Instrumental methods: Event monitor (report examples)

Transtelephonic Report		Pacific Monitoring 8010 Fairwinds Road Ste. 200 Las Vegas, NV 89127 USA 702-216-4412
PATIENT INFORMATION ID : 0000000000 Name : Yasmin Tawse Technician : Date of Birth : Jan 1, 2011 Medications : Indications : Diagnosis :		EVENT INFORMATION Event ID : 00000208-remote_0000 Event Receive Date : 2011-05-25 12:48:10.0 Event Record Date : 2011-05-25 12:48:10.0 Event Type : Receive Technician : 0000000000 Symptoms : Interpretations :
PHYSICIAN INFORMATION Name : MD Address :		
 <div style="float: right; font-size: small;"> Page 1 of 1 Lead II Record 00 Date 05/25/2011 Time 12:48:10 Patient 0000000000 </div>		
Symptoms : Interpretations : Sinus Rhythm Record Date : 2011-05-25 12:48:10.0 Comments :		
 <div style="float: right; font-size: small;"> Page 1 of 1 Lead II Record 00 Date 05/25/2011 Time 12:48:10 Patient 0000000000 </div>		
Symptoms : Interpretations : Sinus Rhythm Record Date : 2011-05-25 12:48:10.0 Comments :		
 <div style="float: right; font-size: small;"> Page 1 of 1 Lead II Record 00 Date 05/25/2011 Time 12:48:10 Patient 0000000000 </div>		
Symptoms : Interpretations : Sinus Rhythm Record Date : 2011-05-25 12:48:10.0 Comments :		

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Transtelephonic Report		Pacific Monitoring 8010 Fairwinds Road Ste. 200 Las Vegas, NV 89127 USA 702-216-4412
PATIENT INFORMATION ID : 0000000000 Name : Yasmin Tawse Technician : Date of Birth : Jan 1, 2011 Medications : Indications : Diagnosis :		EVENT INFORMATION Event ID : 00000209-remote_0000 Event Receive Date : 2011-05-26 11:27:40.0 Event Record Date : 2011-05-26 11:27:40.0 Event Type : Receive Technician : 0000000000 Symptoms : Interpretations :
PHYSICIAN INFORMATION Name : MD Address :		
 <div style="float: right; font-size: small;"> Page 1 of 1 Lead II Record 00 Date 05/26/2011 Time 11:27:40 Patient 0000000000 </div>		
Symptoms : Interpretations : Sinus Rhythm Record Date : 2011-05-26 11:27:40.0 Comments :		

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Instrumental methods: Cardiac stress test (definition & targets)

- A test used to measure the heart's ability to respond to external stress in a controlled clinical environment
- The stress response is induced by exercise or drug stimulation
- Cardiac stress tests compare the coronary circulation while the patient is at rest with the same patient's circulation observed during maximum physical exertion, showing any abnormal blood flow to the heart's muscle tissue (the myocardium)
- The results can be interpreted as a reflection on the general physical condition of the test patient
- This test can be used to diagnose ischemic heart disease, and for patient prognosis after a heart attack (myocardial infarction)

Instrumental methods: Cardiac stress test (stress ECG)

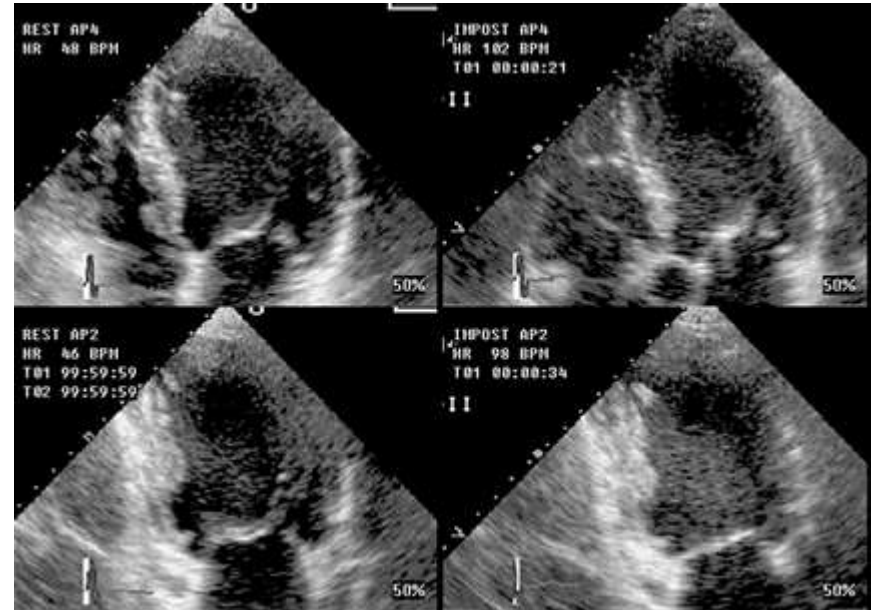
An exercise ECG is done to:

- find the cause of unexplained chest pain or pressure
- decide which treatments are best for a person with angina
- evaluate the patient's ability to tolerate exercise
- find the cause of symptoms that occur during exercise or activity
- evaluate the efficacy of antianginal and antiarrhythmic therapy



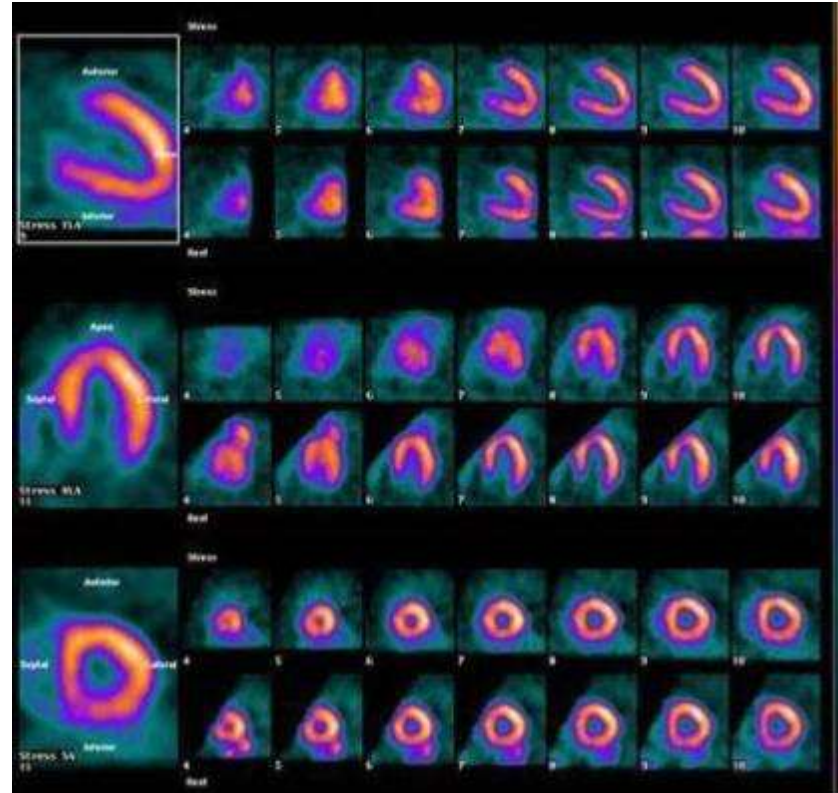
Instrumental methods: Cardiac stress test (stress echocardiography)

- Cardiac stress test may be accompanied by echocardiography
- The echocardiography is performed both before and after the exercise so that structural differences can be compared
- The patient is subjected to stress in the form of exercise or chemically induced stress (usually dobutamine)
- This is used to detect obstructive coronary artery disease



Instrumental methods: Cardiac stress test (nuclear stress test)

- A test measures blood flow to patient's heart at rest and stress as a result of exertion or medication
- The test provides images that can show areas of low blood flow through the heart and damaged heart muscle



Instrumental methods: Electrophysiology study (definition & targets)

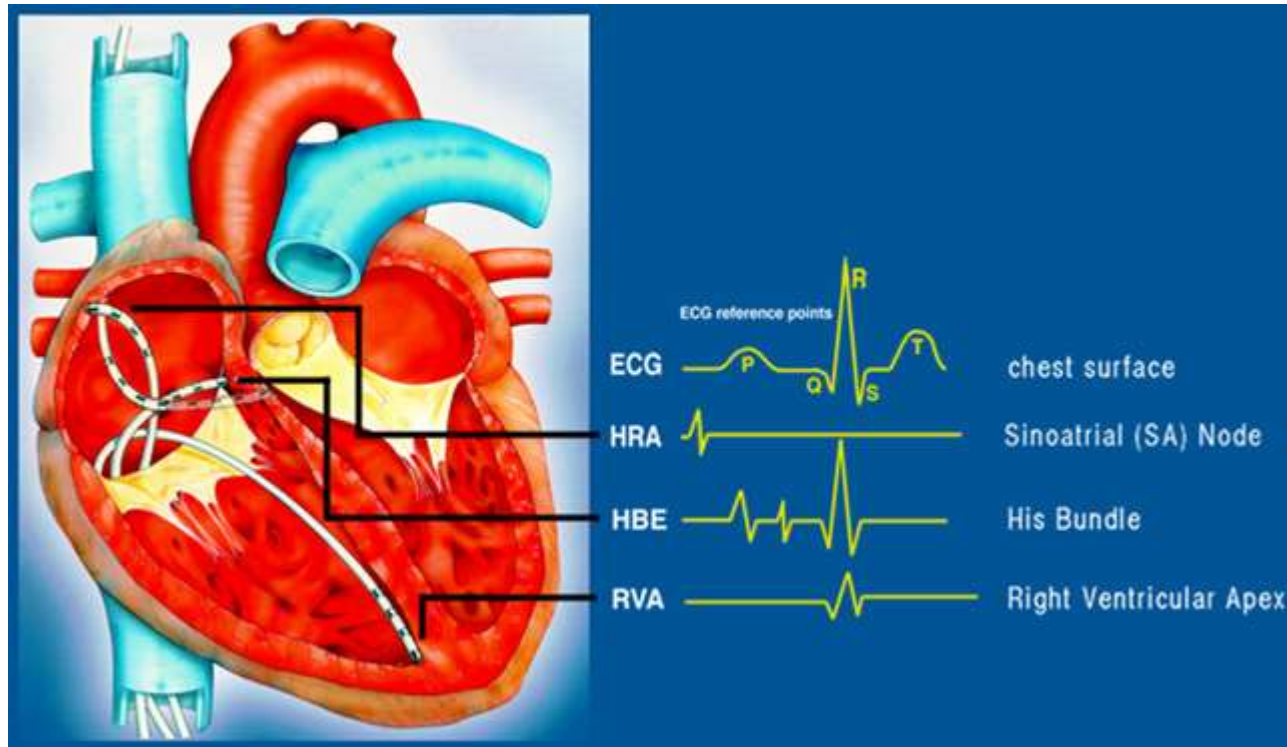
- A minimally invasive procedure that tests the electrical conduction system of the heart
- During electrophysiology study (EPS), sinus rhythm as well as supraventricular and ventricular arrhythmias of baseline cardiac intervals is recorded
- The EPS is indicated to investigate the cause, location of origin, and best treatment for various abnormal heart rhythms
- This type of study is performed by an electrophysiologist and using a single or multiple catheters situated within the heart through a vein or artery

Instrumental methods: Electrophysiology study (Laboratory)



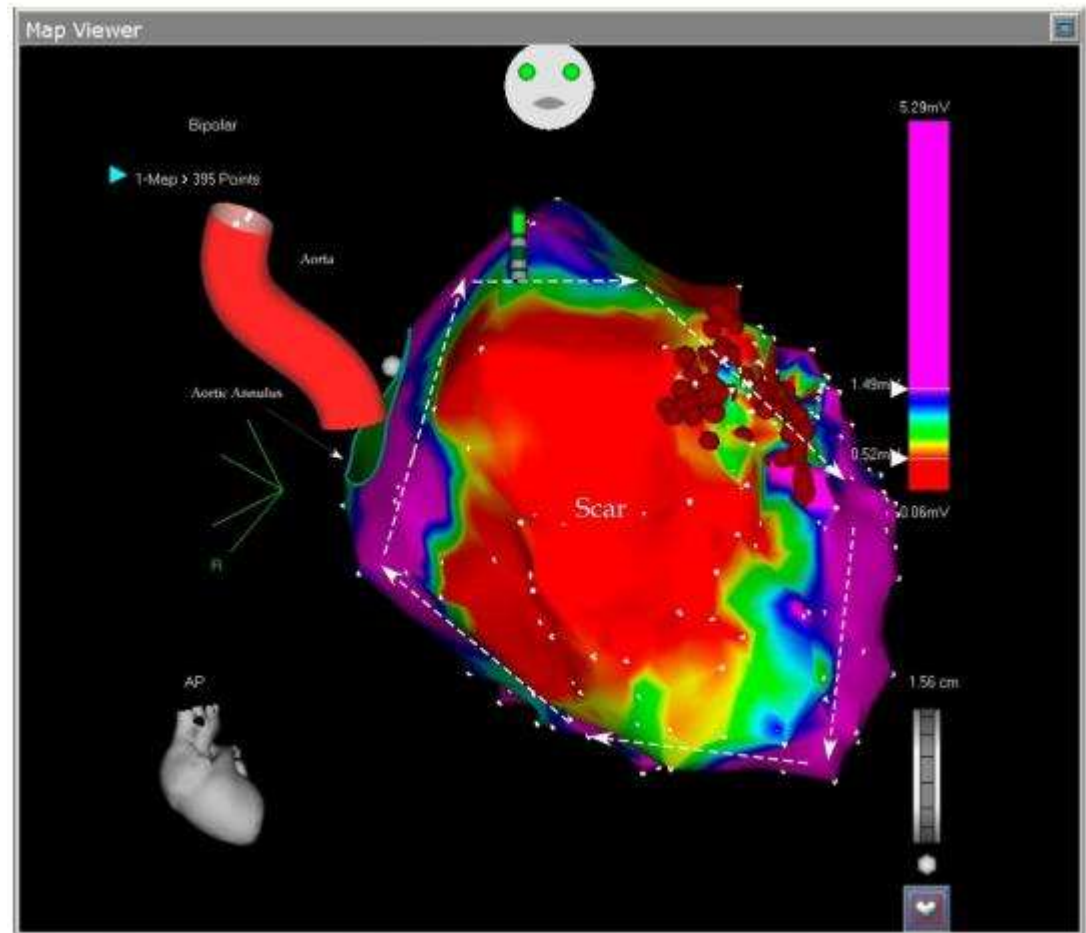
University Mississippi Medical Center

Instrumental methods: Electrophysiology study (technique)



Instrumental methods: Electrophysiology study (results' example)

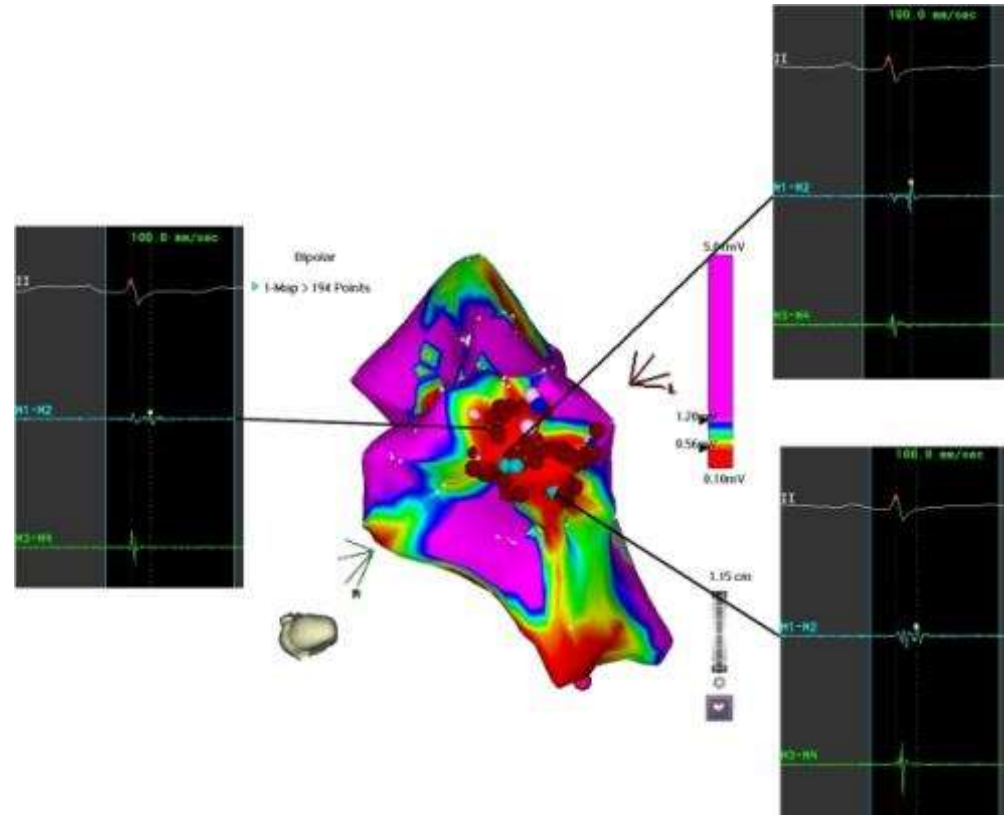
The picture shows
the anteroposterior
projection of the
enlarged left
ventricle with a
large scar on almost
all the anterior wall



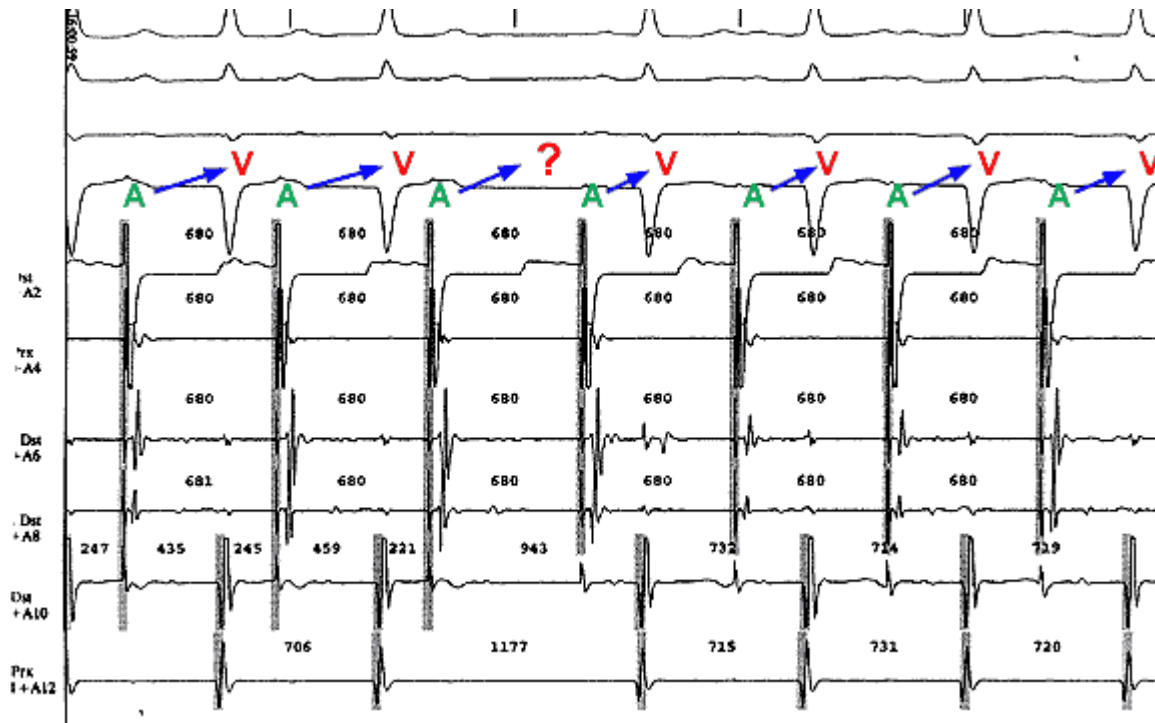
Instrumental methods: Electrophysiology study (results' example)

Voltage map of the right ventricle rotated to show the scar in the apex

Representative signals from three regions within the scar show double potentials with the second component occurring well beyond the end of the QRS



Instrumental methods: Electrophysiology study (results' example)



This image, demonstrates how the Wenckebach cycle length appears during an EPS. The right atrium is being paced on the "RA Dst" channel. The time between A and V increases until the ventricular signal is blocked due to repolarization of the ventricle as indicated by the T wave. The Wenckebach cycle length (600ms) is a significantly abnormal interval

Instrumental methods: Coronary catheterization (definition & targets)

- Cardiac catheterization (cardiac cath, coronary angiogram) is an invasive imaging procedure that tests for heart disease by allowing doctor to "see" the inside of the arteries and how well patient's heart is functioning
- During the test, a long, narrow tube, called a catheter, is inserted into a blood vessel in patient's arm or leg and guided to heart
- Contrast dye is injected through the catheter so that X-ray movies of patient's valves, coronary arteries, and heart chambers can be created

Instrumental methods: Coronary catheterization (device)



University Mississippi Medical Center

Instrumental methods: Coronary catheterization (angiograms)



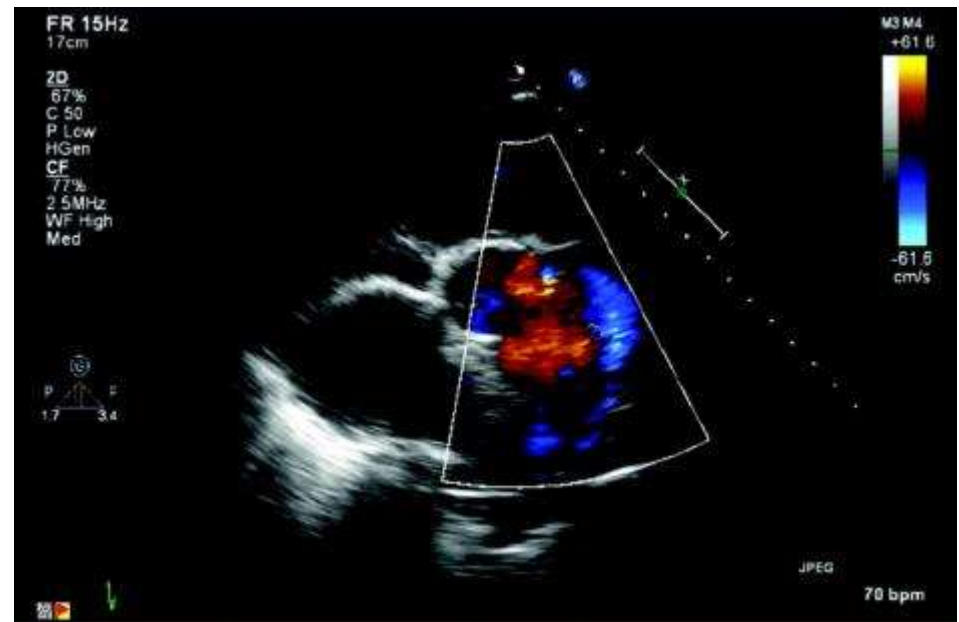
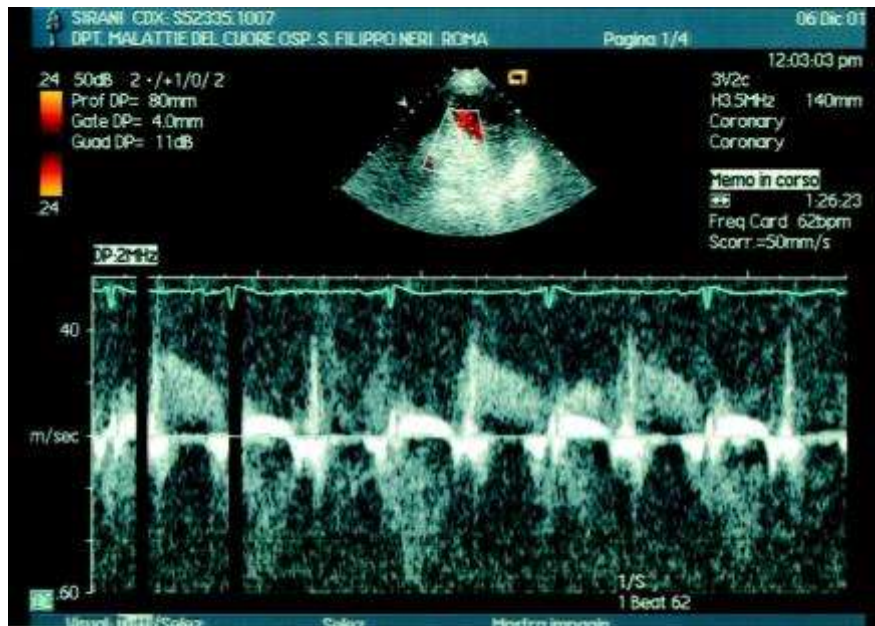
Instrumental methods: Transthoracic echocardiogram (definition & targets)

Transthoracic echocardiogram uses ultrasonic waves for continuous heart chamber and blood movement visualization. In recent times, it has become one of the most commonly used tools in diagnosis of heart problems, as it allows non-invasive visualization of the heart and the blood flow through the heart, using a technique known as Doppler.

Instrumental methods: Transthoracic echocardiogram (device)



Instrumental methods: Transthoracic echocardiogram (results example)



Instrumental methods: Transoesophageal echocardiogram (definition & targets)

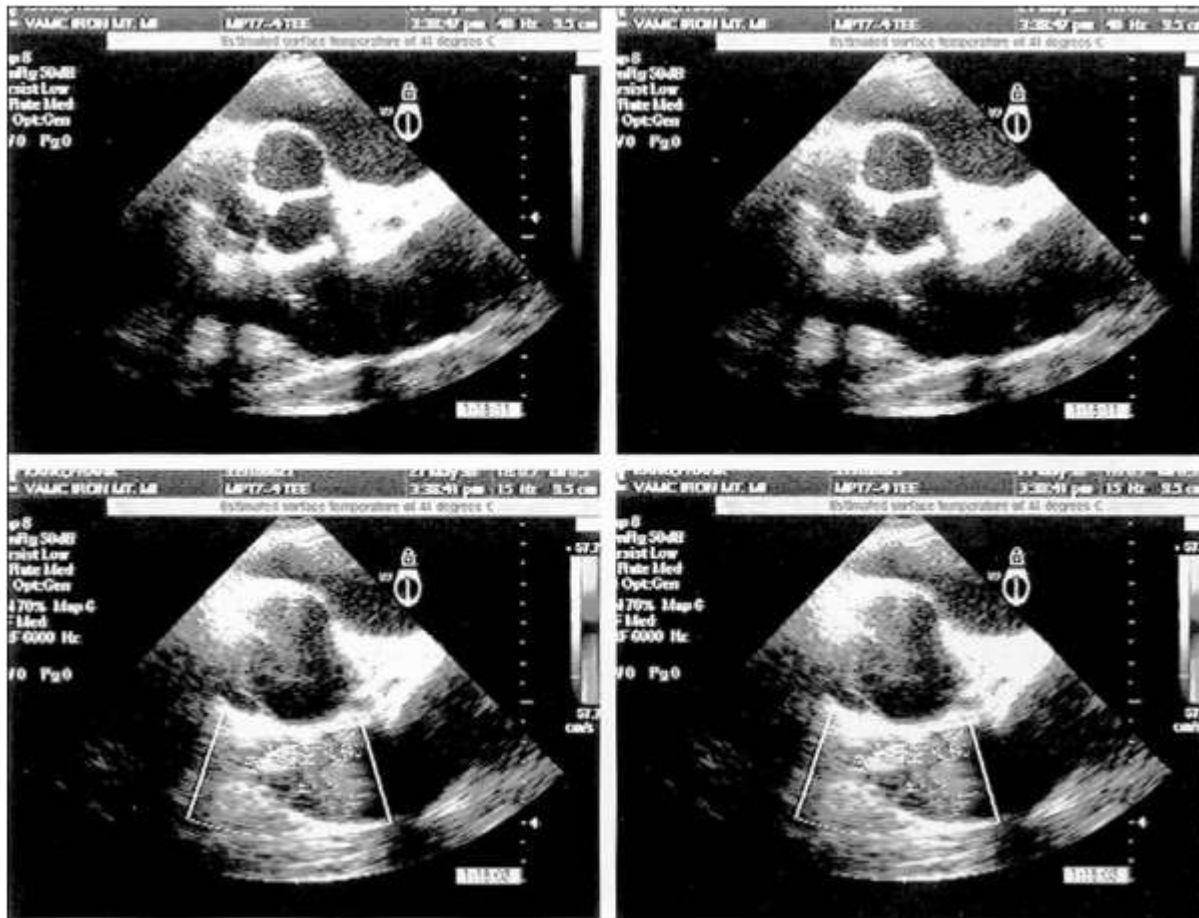
Transoesophageal echocardiogram uses a specialized probe containing an ultrasound transducer at its tip is passed into the patient's esophagus. It is used in diagnosis of various thoracic defects or damage, i.e. heart and lung imaging

Transoesophageal echocardiogram has some advantages and disadvantages over thoracic or intravascular ultrasound

Instrumental methods: Transoesophageal echocardiogram (method)



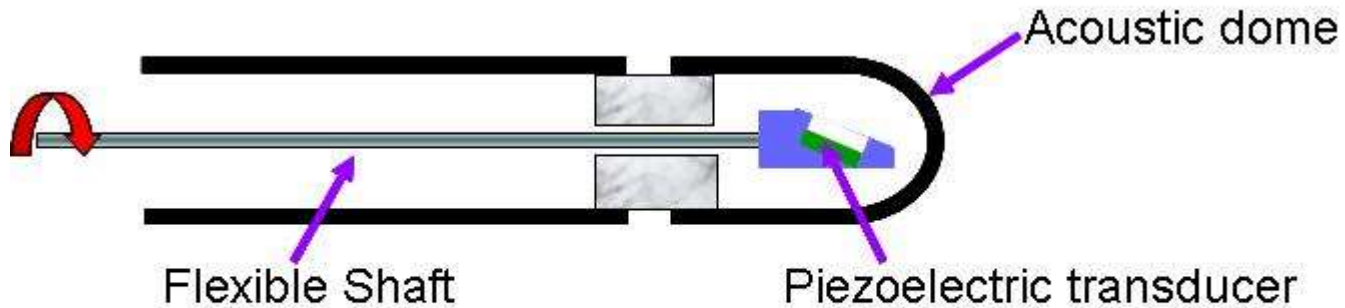
Instrumental methods: Transoesophageal echocardiogram (result example)



Instrumental methods: Intravascular ultrasound (definition & targets)

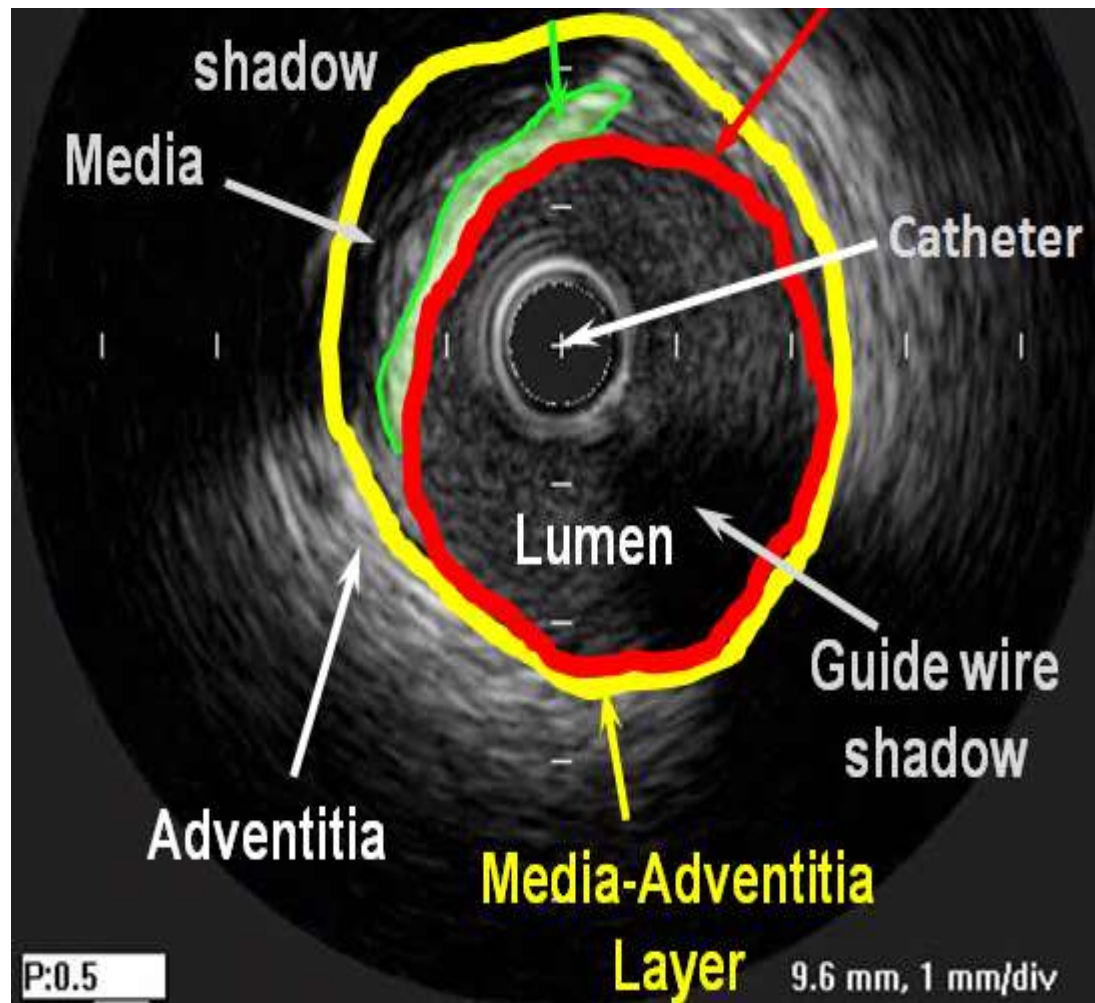
Intravascular ultrasound, also known as a percutaneous echocardiogram is an imaging methodology using specially designed, long, thin, complex manufactured catheters attached to computerized ultrasound equipment to visualize the lumen and the interior wall of blood vessels

Instrumental methods: Intravascular ultrasound (method)



- Principle of intravascular echo element with mechanically rotating element in a catheter

Instrumental methods: Intravascular ultrasound (result example)



Instrumental methods: Positron emission tomography (definition & targets)

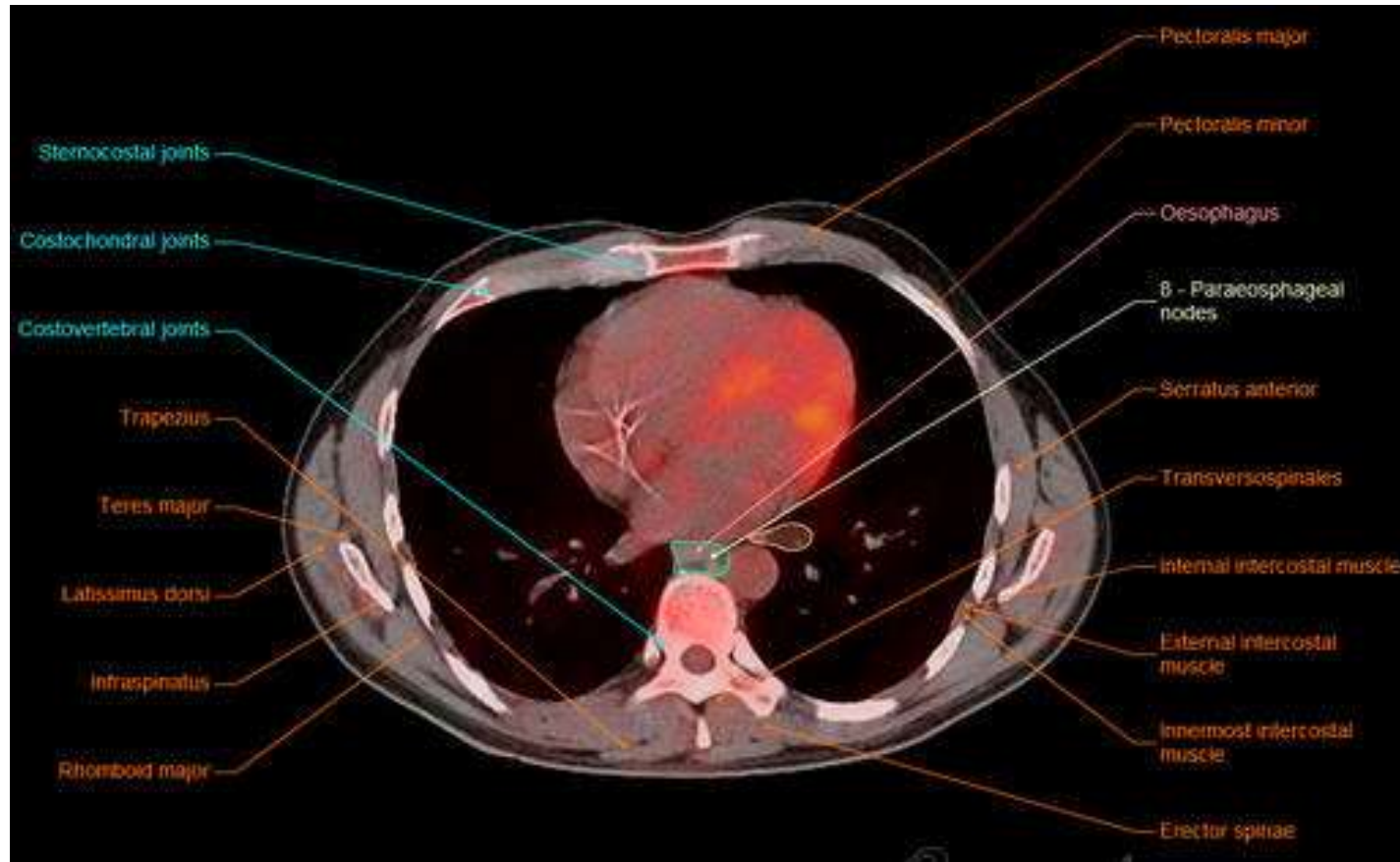
Positron emission tomography (PET), an imaging methodology for positron emitting radioisotopes. PET enables visual image analysis of multiple different metabolic chemical processes and is thus one of the most flexible imaging technologies.

Cardiology uses are growing very slowly due to technical and relative cost difficulties. Most uses are for research, not clinical purposes. Appropriate radioisotopes of elements within chemical compounds of the metabolic pathway being examined are used to make the location of the chemical compounds of interest visible in a PET scanner constructed image.

Instrumental methods: Positron emission tomography (device)



Instrumental methods: Positron emission tomography (result example)



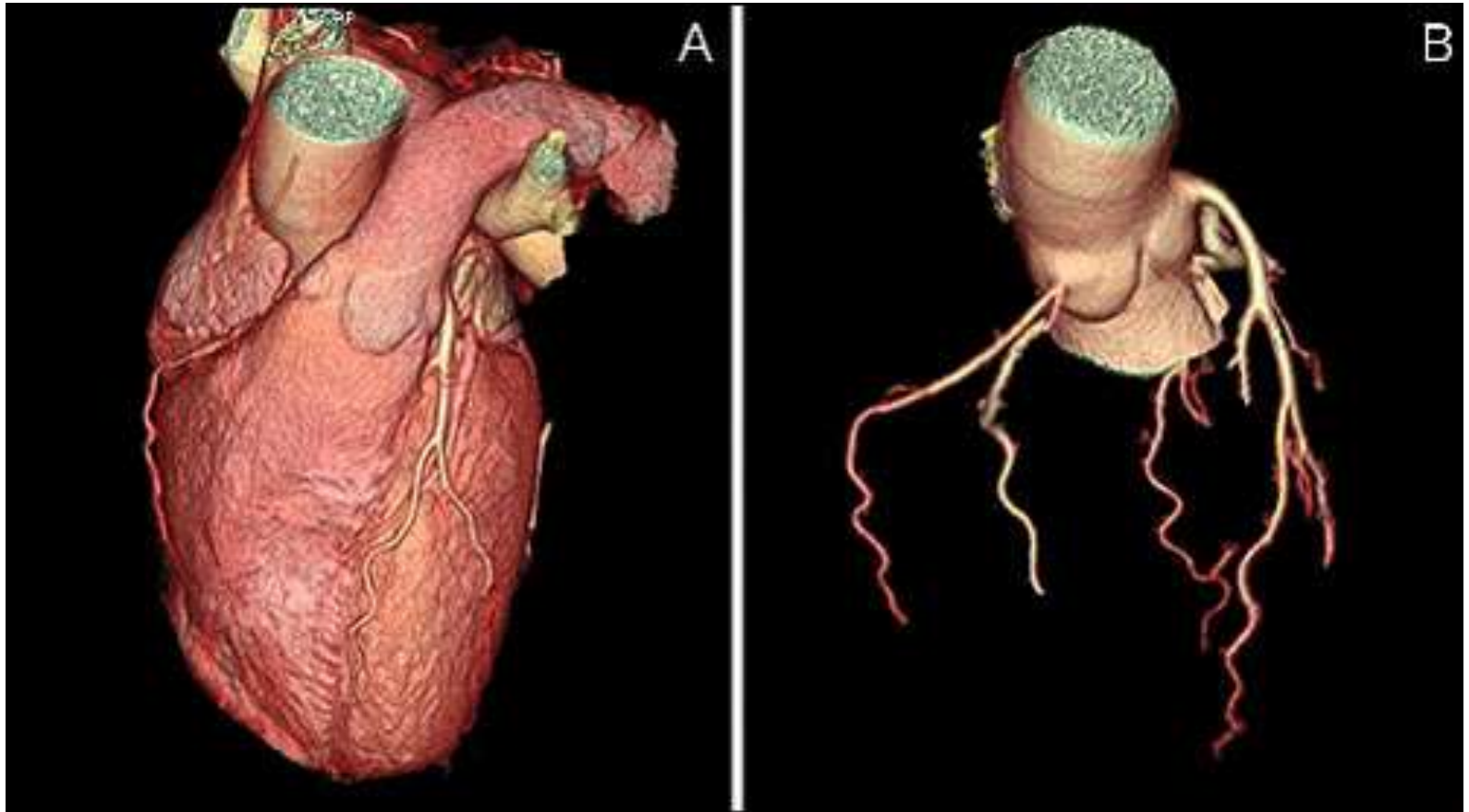
Instrumental methods: Computed tomography angiography (definition & targets)

- Computed tomography angiography (CTA), an imaging methodology using a ring-shaped machine with an X-Ray source spinning around the circular path so as to bathe the inner circle with a uniform and known X-Ray density
- Great development and growth will be seen in the short term, allowing radiologists to diagnose cardiac artery disease without anesthesia and in a non-invasive way

Instrumental methods: Computed tomography angiography (device)



Instrumental methods: Magnetic resonance imaging (result example)



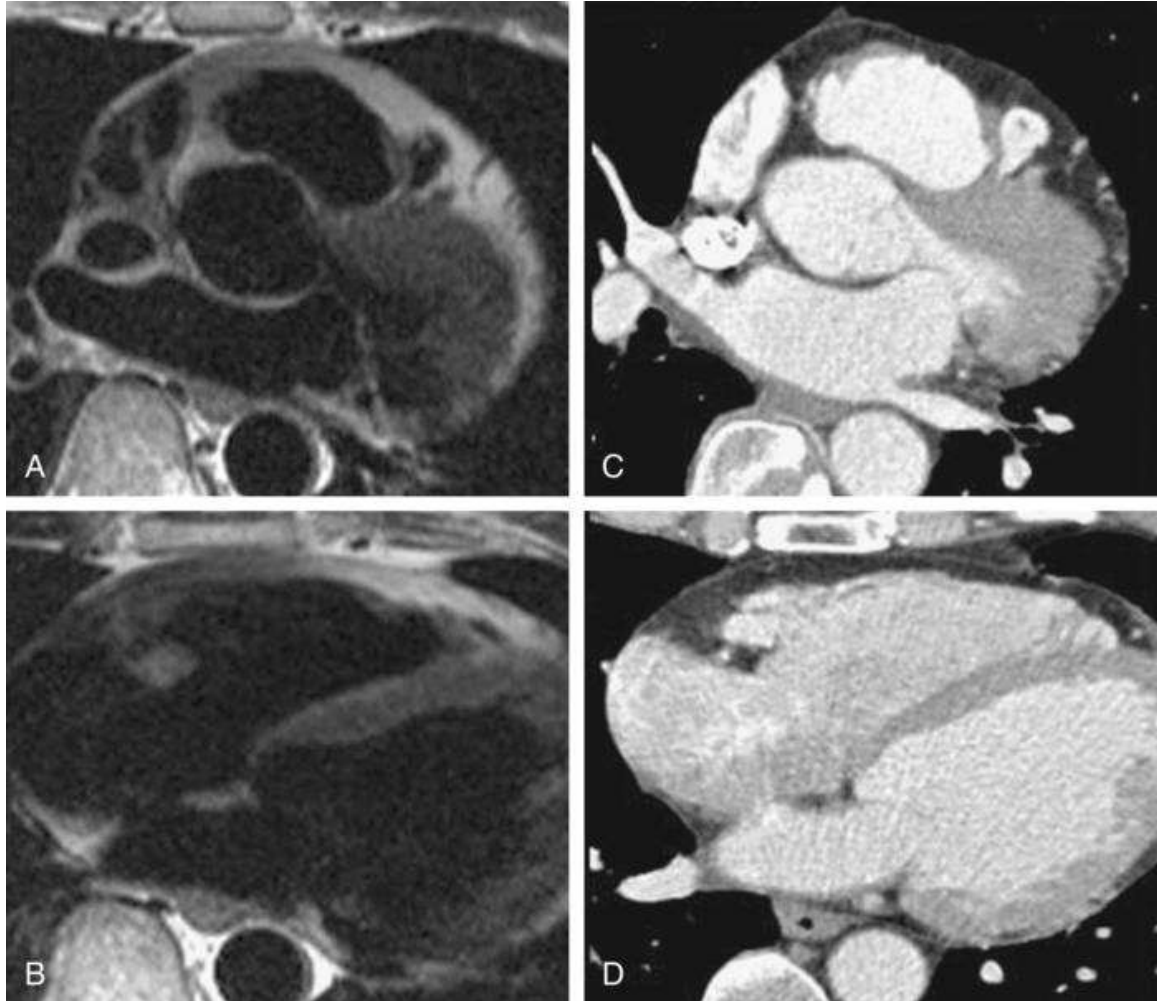
Instrumental methods: Magnetic resonance imaging (definition & targets)

- Magnetic resonance imaging (nuclear magnetic resonance imaging, MRI), an methodology based on aligning the spin axis of nuclei within molecules of the object being visualized using both powerful superconducting magnets and radio frequency signals and detectors
- MRI differentiates soft tissues better than computed tomography and allows for comprehensive exams including the quantitative assessment of size, morphology, function, and tissue characteristics in one single session

Instrumental methods: Magnetic resonance imaging (device)



Instrumental methods: Magnetic resonance imaging (result example)



Instrumental methods: med tech that transform the world

CardioDefender
diagnostic system, a
smartphone ECG that
can provide continuous
readings throughout
the day that can help
detect arrhythmias that
may be hard to spot in
an office visit



Instrumental methods: med tech that transform the world

- Wireless Blood Pressure Monitor
- Easy and precise self-measurement of blood pressure with personal smartphone



Instrumental methods: med tech that transform the world

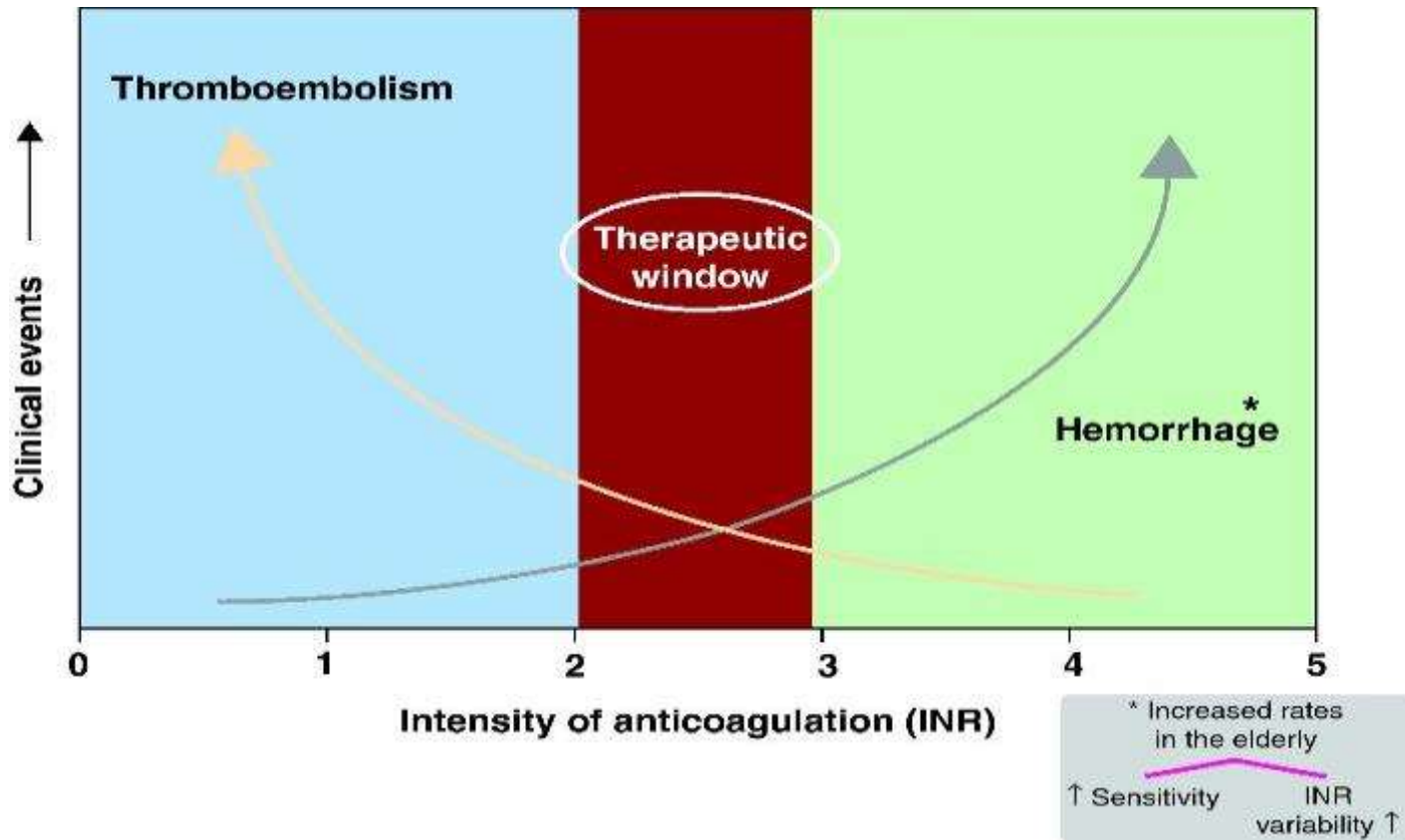
- A health-tracking wristband that could give health care professionals real-time information on the well-being of their patients.
- The wearable can measure a patient's pulse, activity level, skin temperature, heartbeat rhythm, light levels and light exposure



Laboratory methods: Ordinary tests kit

- Blood count
- Blood sugar tests
- Blood tests for those taking anticoagulants (Blood thinners)
- Blood tests to determine risk of coronary artery disease
- B-type natriuretic peptide (BNP) blood test
- Electrolytes
- Enzyme & protein blood tests
- Lipid blood tests
- Thyroid blood tests
- Urine Albumin/Creatinine Ratio (U alb/Cr)

Laboratory methods: Blood thinners



- Prothrombin Time (PT): Normal range for an adult: 9.9-13 seconds
- International Normalized Ratio (INR): Normal level for an adult: 0.9 – 1.2

Laboratory methods: tests to determine risk of coronary artery disease

- Lipoprotein a (Lp(a)) associated with higher risk of heart attack and stroke, desirable level for adults: less than 30 mg/dL
- Apolipoprotein A1 (Apo A1) is the major protein of HDL, low level is associated with increased risk of early cardiovascular disease, desirable level for adults: more than 123 mg/dL
- Apolipoprotein B (ApoB) found in cholesterol particles, ApoB may be a better overall marker of risk than LDL alone, goal values: less than 100 mg/dL for those with low/intermediate risk, less than 80 mg/dL for high-risk individuals, such as those with cardiovascular disease or diabetes

Laboratory methods: B-type natriuretic peptide (BNP) blood test

- "Non-traditional" blood protein made in the heart and found in the blood
- High levels are associated with increased risks of cardiovascular disease, heart attack and heart failure development
- Elevated levels are associated with development of heart failure and worse prognosis
- Goal values: less than 125 pg/mL

Laboratory methods: Enzyme & protein blood tests

- Alanine Aminotransferase (ALT; also called SGPT), goal value: 5 – 50 U/L
- Aspartate Aminotransferase (AST; SGOT), goal value: 7 – 40 U/L
- Creatinine (Cr), goal value: 0.7 – 1.4 mg/dL
- Creatine Kinase (CK), goal value: 30 – 220 U/L
- Lactate dehydrogenase (LDH), goal value: 100 - 220 U/L
- Myoglobin (Mb), goal value: 30 – 90 µg/mL
- Troponin T (cTNT), goal value: 0.0 - 0.10 µg/mL

Laboratory methods: Lipid blood tests

- Total cholesterol. A high level can put you at increased risk of heart disease. Ideally, total cholesterol should be below 200 milligrams per deciliter (mg/dL), or 5.2 millimoles per liter (mmol/L)
- Low-density lipoprotein (LDL) cholesterol. Too much of it in blood causes the accumulation of fatty deposits (plaques) in arteries (atherosclerosis). Ideally, your LDL cholesterol level should be less than 130 mg/dL (3.4 mmol/L), and under 100 mg/dL (2.6 mmol/L) is even better
- High-density lipoprotein (HDL) cholesterol. Ideally, your HDL cholesterol level should be 60 mg/dL (1.6 mmol/L) or higher, though it's common that HDL cholesterol is higher in women than men.
- Triglycerides. High levels increase risk of heart disease. Ideally, triglyceride level should be less than 150 mg/dL (1.7 mmol/L)

Laboratory methods: C-reactive protein

- CRP is a sign of inflammation somewhere in the body
- Inflammation plays a central role in the process of atherosclerosis, in which fatty deposits clog arteries
- CRP test result can be interpreted as putting heart disease risk at:
 - Low risk (less than 1.0 milligrams per liter, or mg/L)
 - Average risk (1.0 to 3.0 mg/L)
 - High risk (above 3.0 mg/L)

Laboratory methods: Thyroid blood tests

- Thyroid Stimulating Hormone (TSH), normal range for an adult: 0.4 – 5.5 mU/mL
- Thyroxine (T4), normal range for an adult: 5 – 11 µg/dL
- Microsomal Thyroid Antibodies (TPO), desirable level for an adult: 0.0 - 5.0 IU/mL

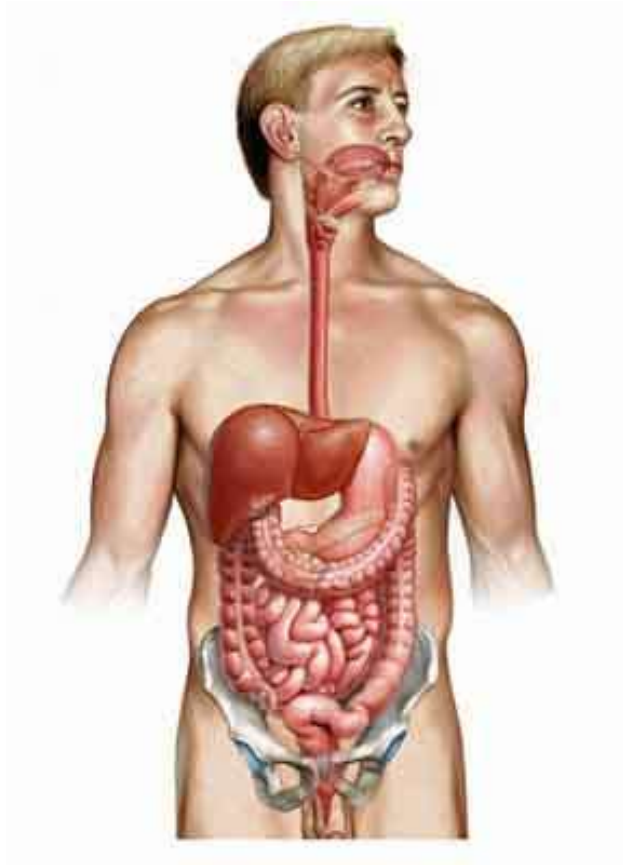
Laboratory methods: Urine Albumin/Creatinine Ratio (U alb/Cr)

- Albumin is a protein found in urine (U alb) that can be a sign of increased risk for kidney disease, diabetes complications and cardiovascular risks
- If elevated levels of U alb/CR are present, close attention to blood pressure control, including use of specific blood pressure medications that help protect the kidney, may be recommended
- Goal values: more than 30 mg/g indicates increased risk for CVD and diabetic nephropathy and more than 300 mg/g indicates clinical nephropathy

Lecture 5

Approach to the patient with
gastrointestinal tract diseases

Plan of the lecture



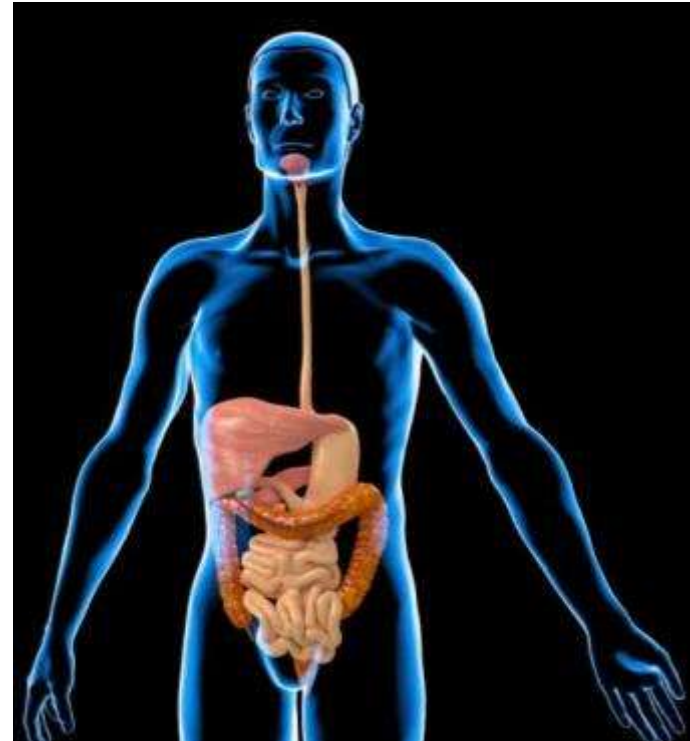
Approach to the Patient with
Gastrointestinal tract
diseases

- Interviewing of the patient
- Physical examination of the patient
- Instrumental methods
- laboratory methods

Gastrointestinal tract diseases

Diseases involving the gastrointestinal tract:

- Esophagus
- Stomach
- Small intestine
- large intestine
- Rectum



Interviewing of the patient: Good questions to get started on the core interview



- Communication skills:
- Active listening
- Empathy
- Building rapport
- Open-ended questions
- Leading questions
- Silence
- “Why” questions
- Nonverbal communication cues

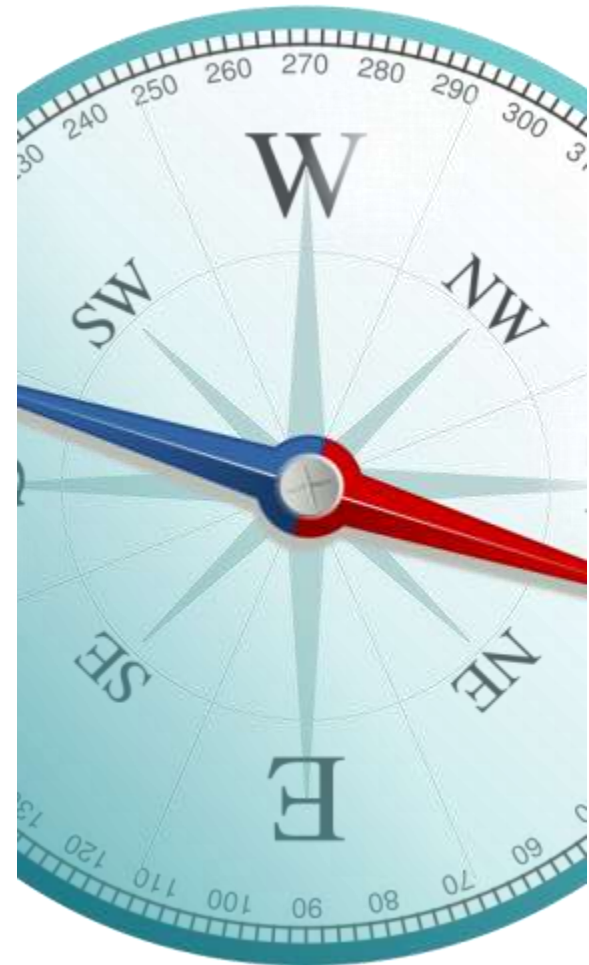
Interviewing of the patient: Good questions to get started on the core interview

- What is your chief complaint?
- Tell me why you're here today
- Tell me about your injury
- What can I do to help you?
- Explain to me your understanding of your injury



Interviewing of the patient: Patient profile

- Age
- Sex
- Race/Ethnicity
- Handedness
- Ht-Wt-BMI-Body type
- Primary language
- Barriers to learning
- Learning preference
- Unique rehabilitation goals



Interviewing of the patient: Chief complaints

- Abdominal Pain
- Heartburn
- Belching
- Indigestion/dyspepsia
- Bloating (Flatulence)
- Constipation
- Diarrhea (acute, chronic)
- Nausea and Vomiting
- Hemorrhoids
- Stool admixtures



Interviewing of the patient: Chief complaints’ “red flags”

- Fever
- Acute/persistent diarrhea
- Persistent constipation
- Blood in stools (tarry stool)
- Persistent nausea or vomiting
- Vomiting blood
- Severe tenderness of the belly
- Unintended weight loss
- Symptom onset after age 50

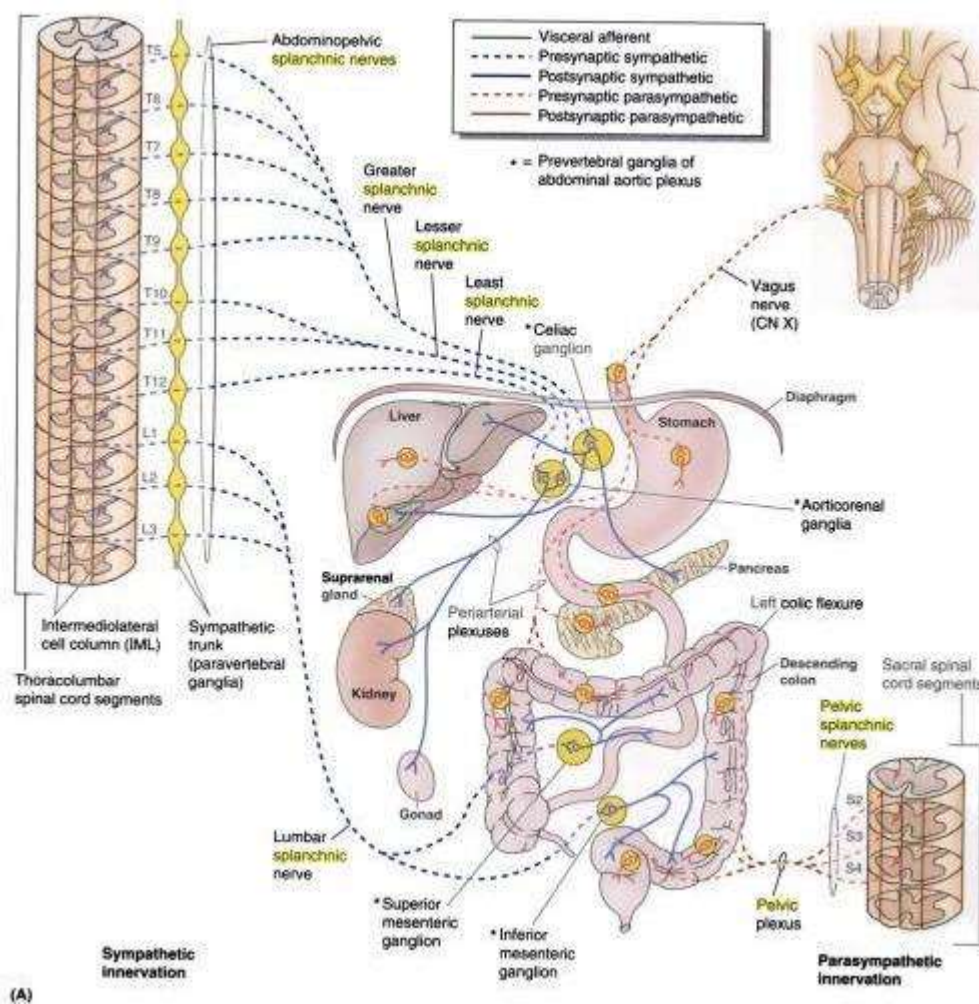


- Dysphagia
- Anorexia or early satiety
- Prior Peptic Ulcer Disease history
- Jaundice
- Palpable abdominal mass
- Rectal bleeding

Interviewing of the patient: Abdominal Pain

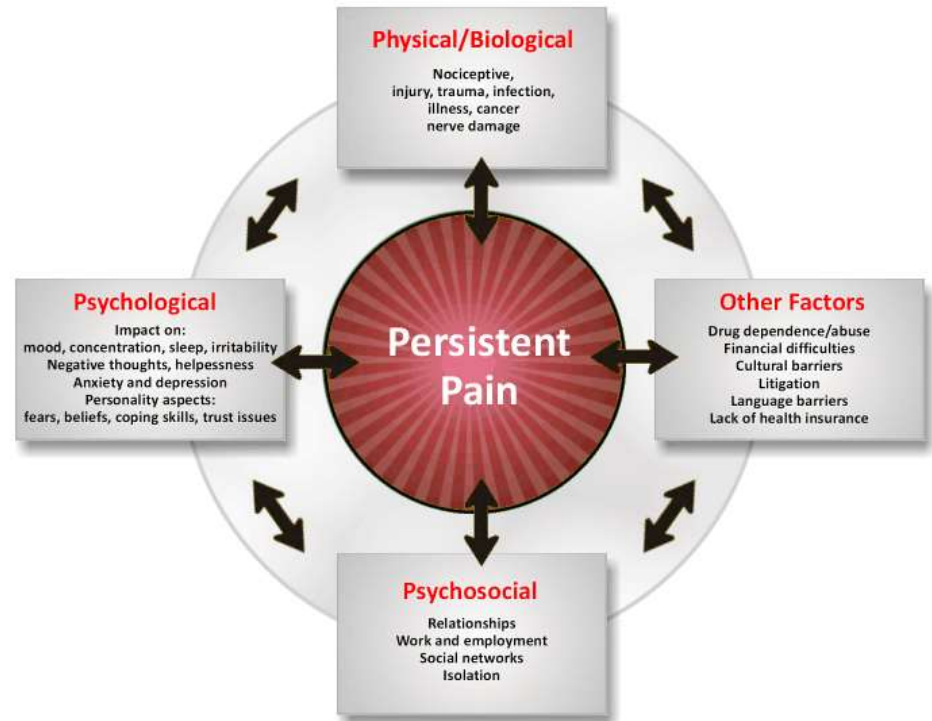
- Nerves are constantly monitoring activities in the body, and when those messages are transmitted to the brain and come into consciousness as unpleasant sensations, we may sense pain or discomfort
- Pain can arise from any of the structures within the abdomen or the abdominal wall
- In addition, pain messages originating in the chest, back, or pelvis can sometimes be perceived as coming from the abdomen (e.g., patients with heart attacks or pneumonia sometimes complain of upper abdominal pain rather than chest pain)

Interviewing of the patient: Abdominal Pain

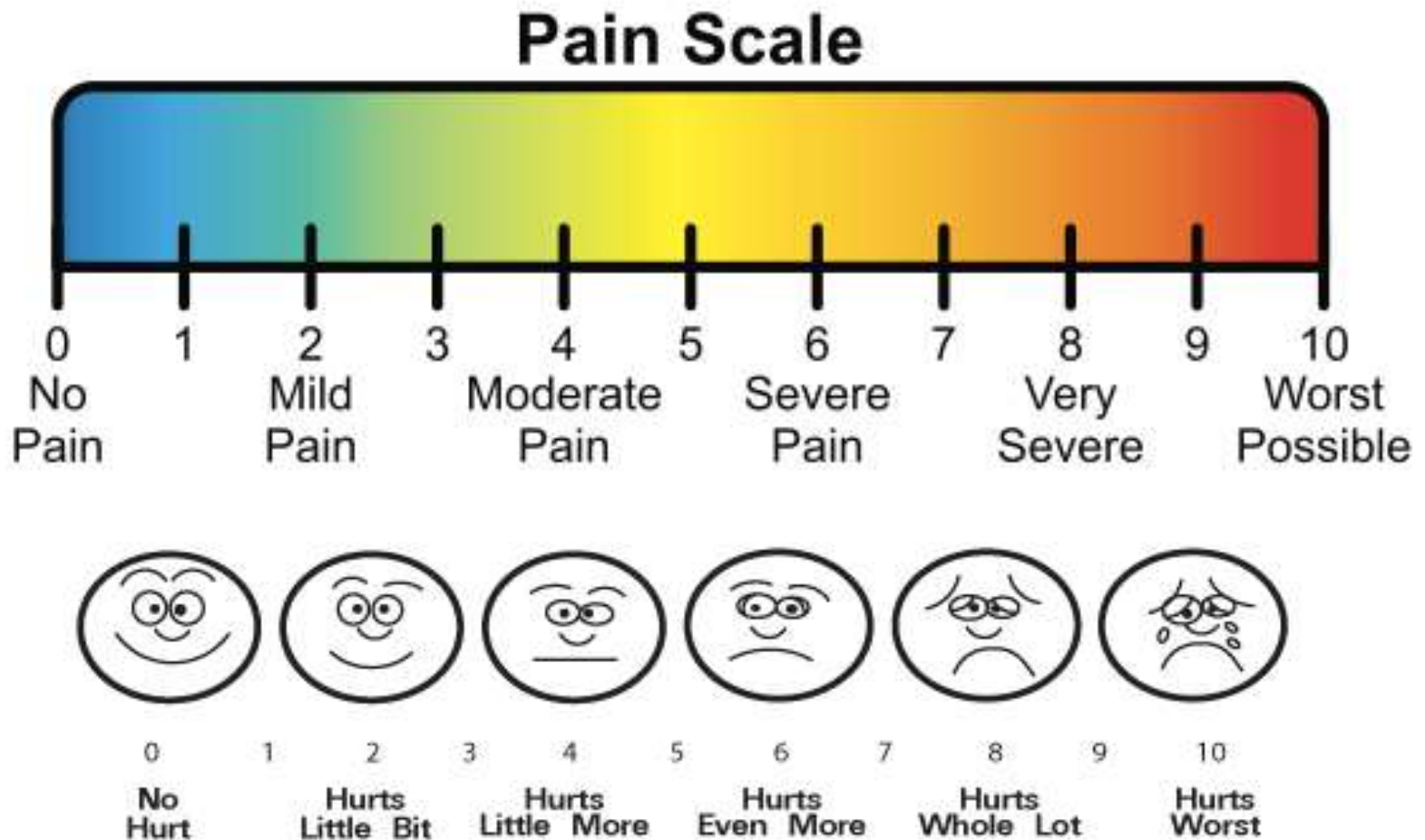


Interviewing of the patient: factors that influence pain

- Physical stress
- Meals
- Emotional stress
- Cold
- Sexual intercourse
- Smoking
- Sleeping problems



Interviewing of the patient: Visual Analog and Numerical Pain Rating Scales



Interviewing of the patient: Common causes of pain

- Non-abdominal causes
- Abdominal or chest wall pain
- Inflammatory conditions of the upper abdomen
- Functional problems of the abdomen
- Cancers of the upper abdomen
- Vascular problems
- Inflammatory conditions in the mid- and lower abdomen
- Bowel obstruction
- Urinary tract problems
- Pelvic problems in women

Common Causes Of Abdominal Pain		
Costochondritis Biliary colic (Gallstones) Gallbladder infection Pulled Muscles Hepatitis Kidney stone Pneumonia	Acid Reflux Heartburn Heart Attack Gastritis Stomach Ulcer Duodenal Ulcer Pancreatitis Epigastric Hernia	Pneumonia Costochondritis Spleen Infection Enlarged Spleen Hepatitis Kidney Stone Constipation Trapped Wind
Kidney Stone Kidney Infection Trapped Wind Constipation Pulled Muscle Appendicitis	Stomach Ulcer Intestinal Obstruction Constipation Worm Infestation Crohns Disease Food Poisoning Trapped Wind Umbilical Hernia	Constipation Trapped Wind Diverticulitis Irritable Bowel Syndrome Kidney Stone / Infection Crohns Ulcerative Colitis
Appendicitis Urine Infection Constipation Ectopic Pregnancy Mid Cycle Pain Pelvic Infection (PID) Endometriosis Ovarian Cyst Trapped Wind Hernia	Trapped Wind Constipation Bladder Infection (Cystitis) Retention Of Urine Menstrual Cramps Endometriosis Pelvic Infection (PID) Fibroids Miscarriage Symphysis Pubis Dysfunction	IBS Crohns Ulcerative Colitis Diverticulitis Constipation Trapped Wind Mid Cycle Pain Endometriosis Pelvic Infection Ovarian Cyst Ectopic Pregnancy

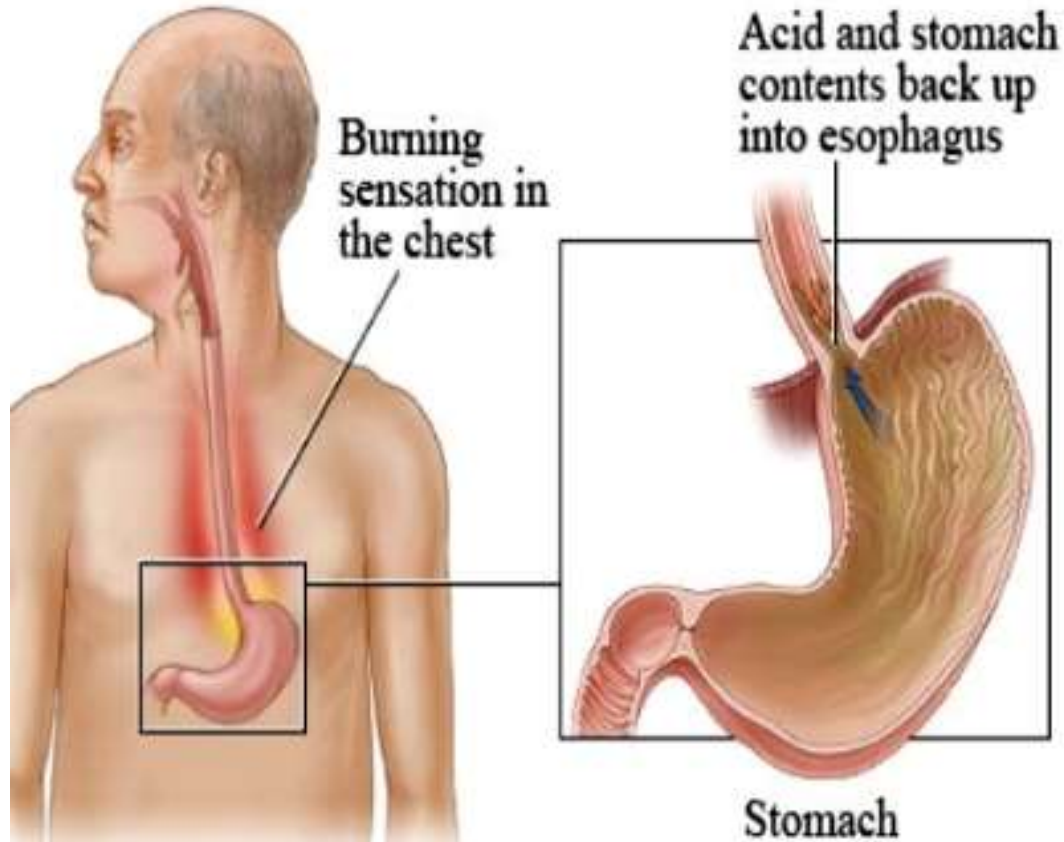
Interviewing of the patient: OPQRST mnemonic

- **O**nset of the event: what the patient was doing when it started (active, inactive, stressed), whether the patient believes that activity prompted the pain, and whether the onset was sudden, gradual or part of an ongoing chronic problem
- **P**rovocation or palliation: whether any movement, pressure (such as palpation) or other external factor makes the problem better or worse
- **Q**uality of the pain: this is the patient's description of the pain
- **R**egion and radiation: where the pain is on the body and whether it radiates (extends) or moves to any other area
- **S**everity: the pain score (usually on a scale of 0 to 10)
- **T**ime (history): how long the condition has been going on and how it has changed since onset (better, worse, different symptoms), whether it has ever happened before, whether and how it may have changed since onset, and when the pain stopped if it is no longer currently being felt.

Interviewing of the patient: Heartburn

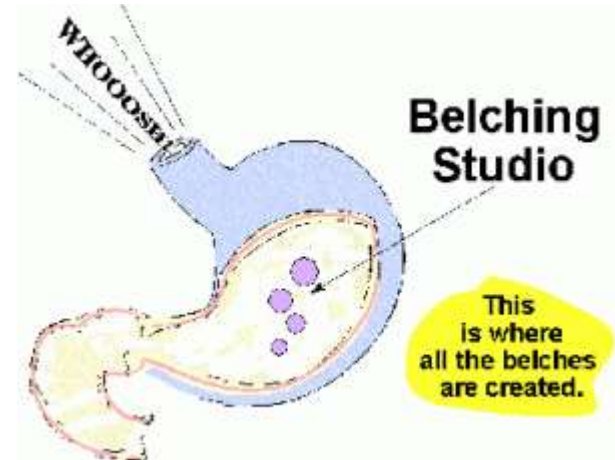
- Symptoms of heartburn, also known as acid indigestion, are more common among the elderly and pregnant women
- Most people will experience heartburn if the lining of the esophagus comes in contact with too much stomach juice for too long a period of time
- The stomach juice consists of acid, digestive enzymes, and other injurious materials and the prolonged contact of acidic stomach juice with the esophageal lining injures the esophagus and produces a burning discomfort
- Normally, a muscular valve at the lower end of the esophagus called the lower esophageal sphincter or “LES” — keeps the acid in the stomach and out of the esophagus
- In gastroesophageal reflux disease or GERD, the LES relaxes too frequently, which allows stomach acid to reflux, or flow backward into the esophagus

Interviewing of the patient: Heartburn



Interviewing of the patient: Belching

- The act of bringing up air from the stomach
- IT is most often a normal process
- The buildup of air in the upper stomach causes the stomach to stretch
- Excessive or repeated belching may be caused by swallowing air without realizing it (aerophagia)
- Belching may last longer or be more forceful depending on what is causing it
- Symptoms such as nausea, dyspepsia, and heartburn may be relieved by belching

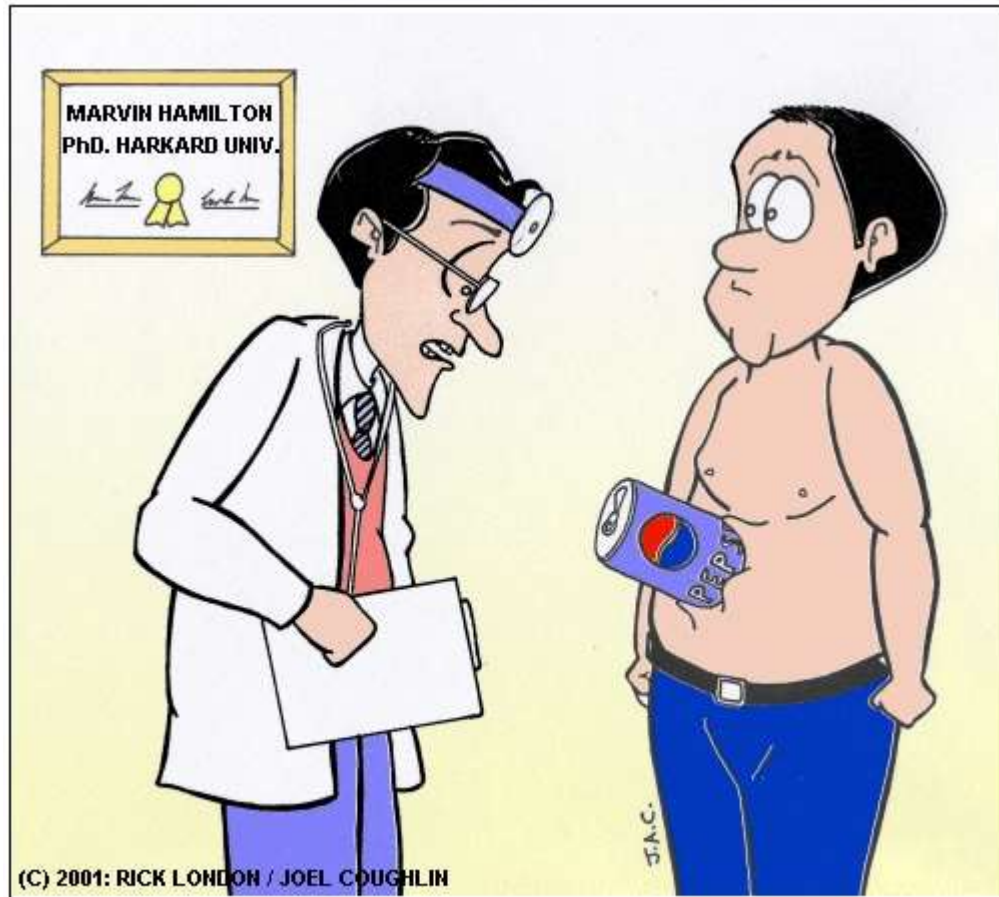


Interviewing of the patient:

Indigestion/dyspepsia

- Indigestion, also known as dyspepsia, is a term used to describe one or more symptoms including a feeling of fullness during a meal, uncomfortable fullness after a meal, and burning or pain in the upper abdomen
- Indigestion is common in adults and can occur once in a while or as often as every day
- Indigestion symptoms:
 - Fullness during a meal
 - Bothersome fullness after a meal
 - Epigastric pain
 - Epigastric burning

Interviewing of the patient: Indigestion/dyspepsia



LOOKS LIKE DYSPEPSIA, RALPH

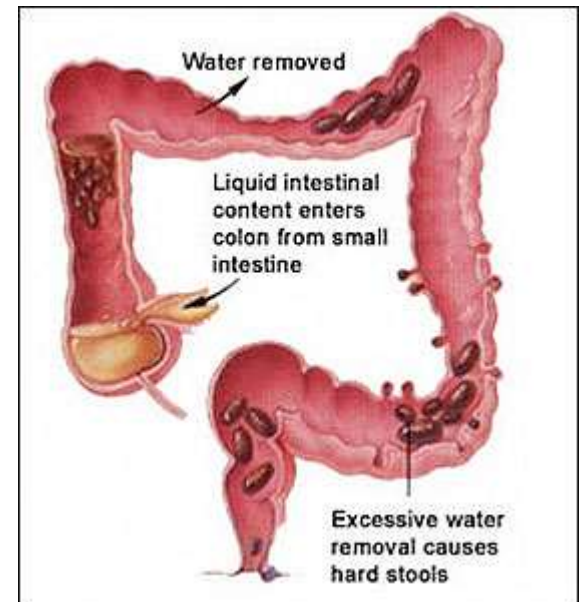
Interviewing of the patient: Bloating & Flatulence

- Bloating refers to a sense of fullness in the upper abdomen and can be influenced by gas and/or food accumulation in the stomach
- Flatulence refers to the passage of rectal gas produced by the action of colon bacteria on undigested carbohydrates.
- Gas which accumulates in the right upper portion of the colon can lead to pain which could seem like gallbladder pain
- Gas which accumulates in the left upper portion of the colon can radiate up to the chest and seem like cardiac pain



Interviewing of the patient: Constipation

- Constipation (costiveness, dyschezia) refers to bowel movements that are infrequent or hard to pass
- Constipation is a common cause of painful defecation
- Severe constipation includes obstipation (failure to pass stools or gas) and fecal impaction, which can progress to bowel obstruction and become life-threatening
- Two types of constipation : obstructed defecation and colonic slow transit (or hypomobility)



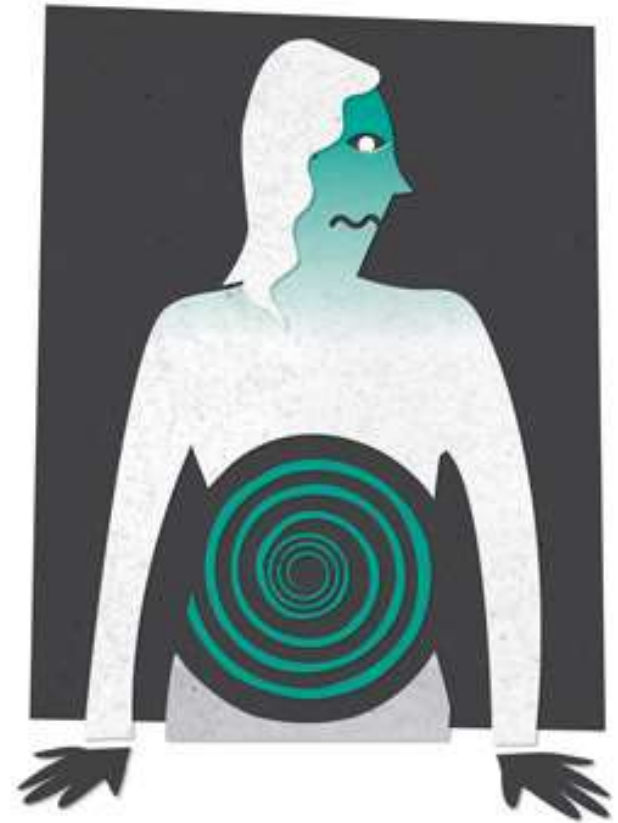
Interviewing of the patient: Diarrhea (acute, chronic)

- Diarrhea (diarrhoea) is the condition of having at least three loose or liquid bowel movements each day
- It often lasts for a few days and can result in dehydration due to fluid loss
- Signs of dehydration often begin with loss of the normal stretchiness of the skin and changes in personality
- This can progress to decreased urination, loss of skin color, a fast heart rate, and a decrease in responsiveness as it becomes more severe



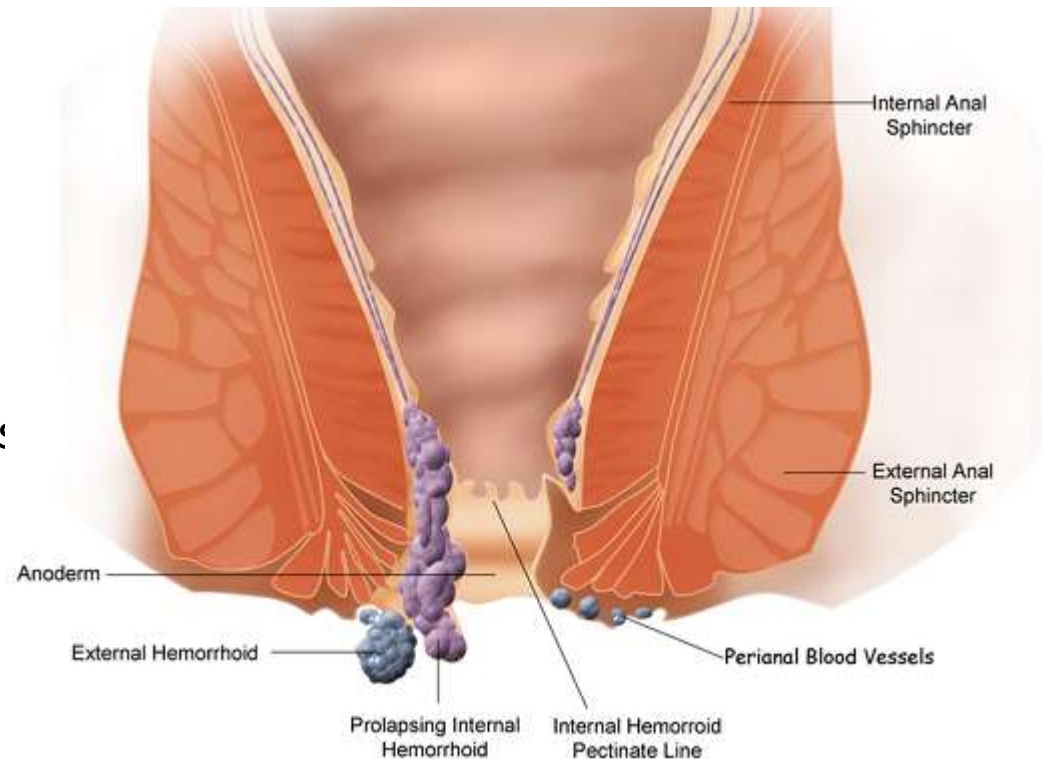
Interviewing of the patient: Nausea and Vomiting

- Nausea is the unpleasant urge to vomit, can occur without vomiting or may precede vomiting
- Vomiting is the forceful ejection of stomach contents through the mouth, this generally a protective mechanism to remove harmful ingested substances can occur from many unrelated infectious and inflammatory conditions in the body
- Vomiting must be differentiated from regurgitation, which is the effortless movement of swallowed food contents or stomach acid from the stomach back into the mouth



Interviewing of the patient: Hemorrhoids

- Hemorrhoids (piles) are swollen and inflamed veins in anus and lower rectum
- Hemorrhoids may result from straining during bowel movements or from the increased pressure on these veins during pregnancy, among other causes
- Hemorrhoids may be located inside the rectum (internal hemorrhoids), or they may develop under the skin around the anus (external hemorrhoids)

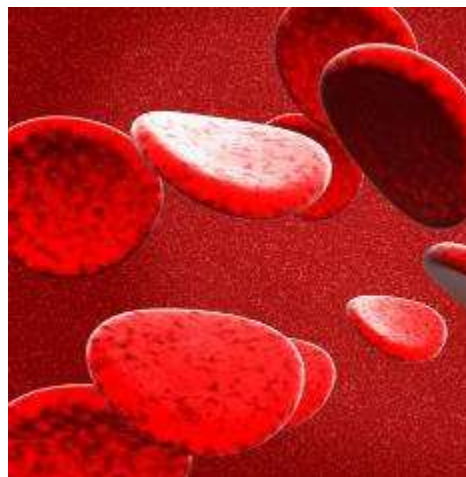


Interviewing of the patient: Blood in stool

- Blood in stool looks different depending on (1) how early it enters the intestines (and thus how much digestive action it has been exposed to) and on (2) how much there is (a little bit, more than a little, or a lot)
- Red blood in the stool has different clinical significance (and a different name) than brown or black blood in the stool
- The term can refer either to melena, with more blackish appearance, originating from upper gastrointestinal bleeding, or to hematochezia, with more red color, originating from lower gastrointestinal bleeding
- The term "blood in stool" is usually not used to describe fecal occult blood, which refers to blood that is not visible and thus is found only after chemical testing is performed

Interviewing of the patient: Vomiting blood

- Vomiting blood (hematemesis) is the regurgitation of stomach contents mixed with blood, or the regurgitation of blood only
- Vomiting blood sounds jarring, but in some cases, it may be triggered by minor causes such as swallowing blood from a mouth



The appearance of the vomitus depends on the amount and character of the gastric contents at the time blood is vomited the length of time the blood has been in the stomach



Gastric acids change bright red blood to a brownish color and the vomitus is often described as 'coffee-ground' in color
Bright red blood in the vomitus indicates a fresh hemorrhage and little contact of the blood with gastric juices

Interviewing of the patient: upper & lower complaints

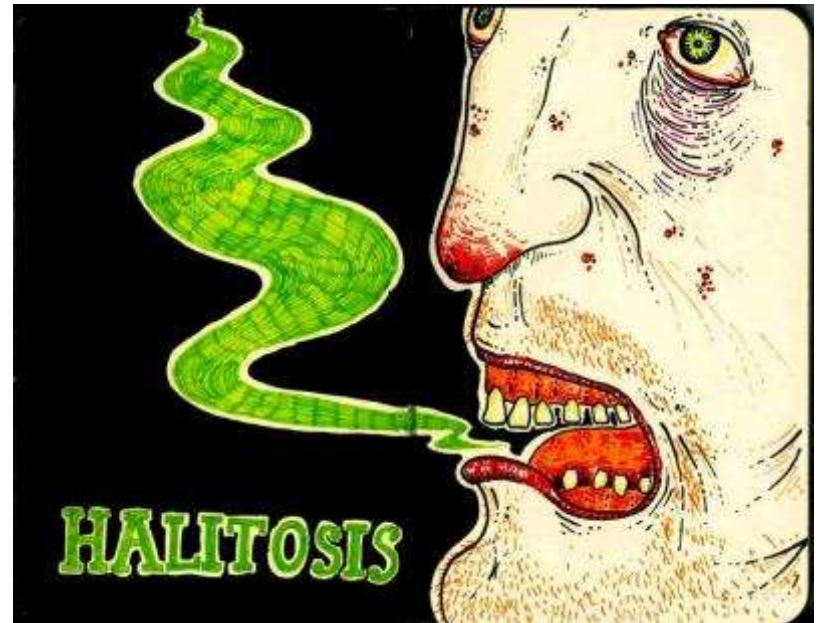
- Upper complaints include chest pain, chronic and recurrent abdominal pain, dyspepsia, lump in the throat, halitosis, hiccups, nausea and vomiting, and rumination
- Some upper GI complaints represent functional illness
- Lower complaints include constipation, diarrhea, gas and bloating, abdominal pain, and rectal pain or bleeding
- As with upper complaints, lower complaints may result from physiologic illness or represent a functional disorder

Interviewing of the patient: list of additional possible complaints

- Dyspnea
- Cough
- Hemoptysis
- Edema
- Syncope
- Irritability
- Numbness/tingling
- Leg swelling
- Overweight
- Weight loss
- Halitosis
- Fever
- Sweatiness
-
- Fatigue
- Headache
- Dizziness
- Sleeplessness
- Dysphagia
- Odynophagia
- Loss of appetite
- Dysorexia (e.g. aversion to meat)
- Admixtures in feces
- Thirst
- Pain in the joints
- Skin changes

Interviewing of the patient: halitosis

- Halitosis (bad breath, feter oris, fege bosta), is a symptom in which a noticeably unpleasant odor is present on the exhaled breath
- Concern about halitosis is estimated to be the third most frequent reason for people to seek dental care, following tooth decay and gum disease; and about 20% of the general population are reported to suffer from it to some degree



Interviewing of the patient: specific questions for set of chief complaints

Each of chief complaints will prompt a series of specific questions that will help arrive at a preliminary single diagnosis, or a group of different diagnoses



Interviewing of the patient: example of specific questions in chief complaint

- Character
- Location
- Severity
- Timing
- Duration
- Radiation
- Provocation
- Relieving conditions
- When did it first start?
- How often does it occur?
- Is appetite good or has it changed?
- What brought it on?
- Were there associated symptoms
- Is it becoming more frequent with time?
- Are the symptoms lasting longer?
- How the symptoms relate to food intake?

Interviewing of the patient: past medical history

In a medical encounter, a past medical history (abbreviated PMH), is the total sum of a patient's health status prior to the presenting problem

The image shows a close-up of a medical form. The section 'Past Medical History' is prominent, with a sub-section for 'Cardiac' conditions. Below this, there are several radio button options: 'None', 'Unknown', 'Angina', 'Arrhythmia', 'Cardiomyopathy', 'CHF', 'Congenital', 'Implanted Defib', and 'Other'. To the right of these options, there are more radio button options: 'None', 'Unknown', 'Abdominal', 'Heart', 'Lung', and 'Neurological'. A black pen is resting on the form, pointing towards the 'Cardiac' section. Other parts of the form visible include 'State', 'Secondary Insurance', 'Weight', and 'Chronic Illnesses'.

Interviewing of the patient: prior or current treatment

- Diet (e.g. gluten-free diet)
- Medications
- Injections
- Gastrointestinal surgery
- Chiropractic
- Exercise/PT (Physical Therapy)
- ER (Emergency Room)
- Massage therapy



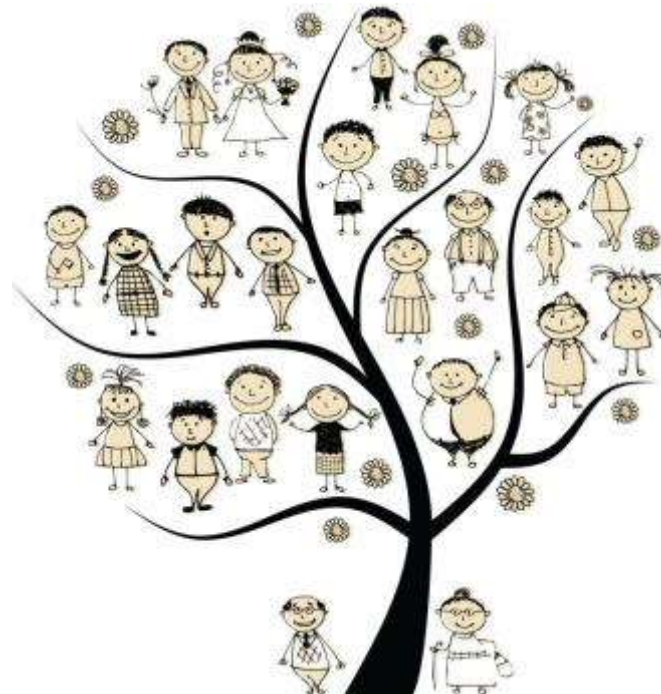
Interviewing of the patient: previous treatment and present status

- Previous Treatment
 - What?
 - Where?
 - When?
 - By whom?
- Present Status
 - Better vs. same vs. worse



Interviewing of the patient: family history and genetic risk

- Certain gastrointestinal illnesses may occur in more than one member of a family
- The physician will inquire about the health of the patient's parents, brothers, sisters and children



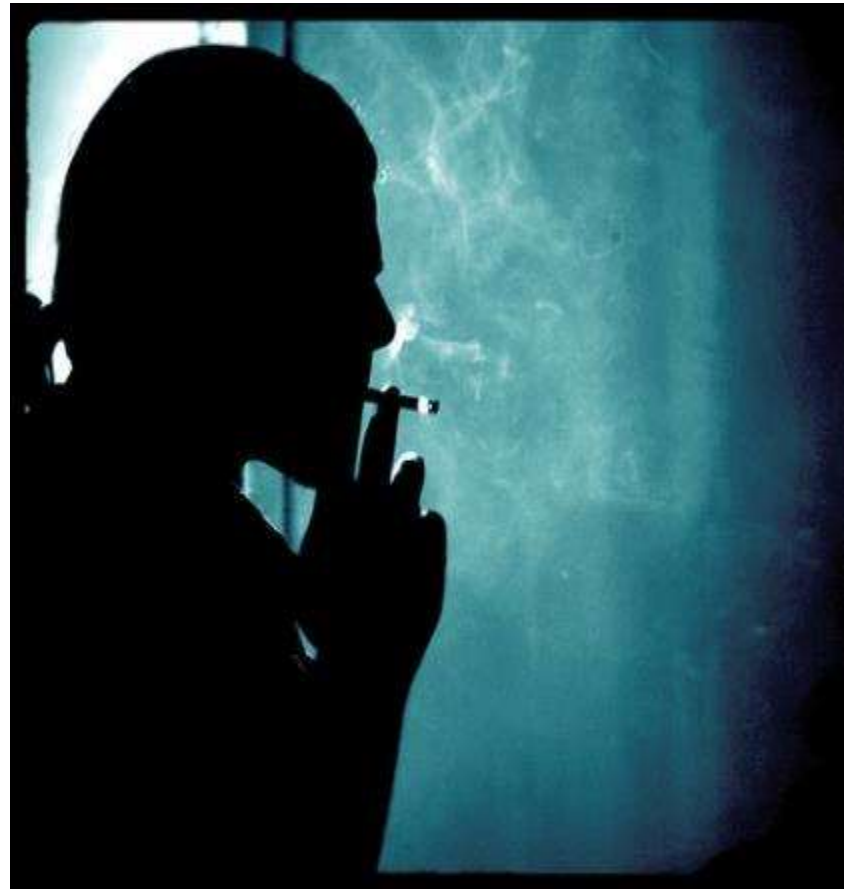
Interviewing of the patient: diet history

- A diet history is important when assessing gastrointestinal tract function
- Many conditions manifest themselves as a result of alterations in dietary intake and absorption of nutrients



Interviewing of the patient: social history

- High-risk behaviors
 - Alcohol, tobacco, or drug abuse
 - Depression
 - Anorexia/bulimia
 - Sedentary lifestyle
- Signs of any of the above behaviors may warrant referral to a secondary provider



Interviewing of the patient: why take a medical history?

- Up 90% of conditions can be accurately diagnosed or recognized by conducting a thorough medical history and listening carefully to the patient's response(s)
- Determines the necessary tests and measures you should prioritize for your objective examination



Interviewing of the patient: review of systems

- The "laundry list" of symptoms related to various organs of the body
- A series of questions helps seek out information that the patient may have neglected to provide the physician
- Review of systems helps to identify the patient's problem, or exclude different parts of the differential diagnosis



Interviewing of the patient: systemic enquiry

- General: fever, weight loss, loss of appetite, lethargy
- Respiratory and cardiovascular systems: shortness of breath, cough, hemoptysis, wheeze, chest pain
- Genito-urinary system: dysuria (pain on passing urine), frequency, terminal dribbling, urethral discharge
- Gynecological system: pelvic pain, vaginal bleeding, vaginal discharge, LMP
- Neurological system: headaches, dizziness, loss of consciousness, fits, faints, funny turns, numbness, tingling, weakness, problems speaking, change in vision

Interviewing of the patient: Gastrointestinal Quality of Life Index

- The Gastrointestinal Quality of Life Index is a questionnaire which measures Quality of Life (GIQLI) of the patient
- GIQLI is a multidimensional construct with several dimensions: emotional or psychological well being, physical functioning, social functioning, and symptoms of the disease and treatment
- A single item is also included that identifies perceived change in health, making the GIQLI a useful indicator for change in GIQLI over time and treatment

Physical examination of the patient: from general inspection to abdomen examination

- General inspection from the end of the bed
- General examination of:
 - Hands / pulse
 - Face
 - Lymph nodes
- Examination of the abdomen
 - Inspection
 - Palpation
 - Percussion
 - Auscultation



Physical examination of the patient: positioning

Step	Position
Inspection	Supine, head and knees supported
Auscultation	Supine, head and knees supported
Palpation	Supine, head and knees supported
Percussion	Supine, head and knees supported
Check for ascites	Supine, may need to roll patient for shifting dullness
Rectal examination	Left lateral decubitus
Inguinal examination	Standing

Physical examination of the patient: general inspection

- Whether patient is comfortable at rest
- Do patient appears to be tachypnoeic
- Are there any obvious patient' skin color changes
- Are there any obvious medical appliances around the bed (such as patient controlled analgesia)
- Are there any medications around (although this is unlikely as all medications should be in a locked cupboard)



Physical examination of the patient: hands inspection

- Temperature
- Skin turgor for hydration
- Koilonychias
- Leukonychia
- Nail clubbing
- Palmar erythema
- Nicotine staining
- Dupuytren's contracture
- Peripheral cyanosis
- radial pulse



Physical examination of the patient: face inspection

- Pale conjunctiva of anaemia
- Yellow sclera of jaundice
- Changes to the tongue e.g. glossitis, macroglossia, ulcers, candidiasis



Physical examination of the patient: neck inspection

- Palpate for enlarged lymph nodes, first from the front, then back/right
- A palpable enlarged supraclavicular (Virchow's) node is known as Troisier's sign which drains the thoracic duct. Enlargement of this node may suggest metastatic deposits from a malignancy in any of these areas (e.g. gastric cancer)

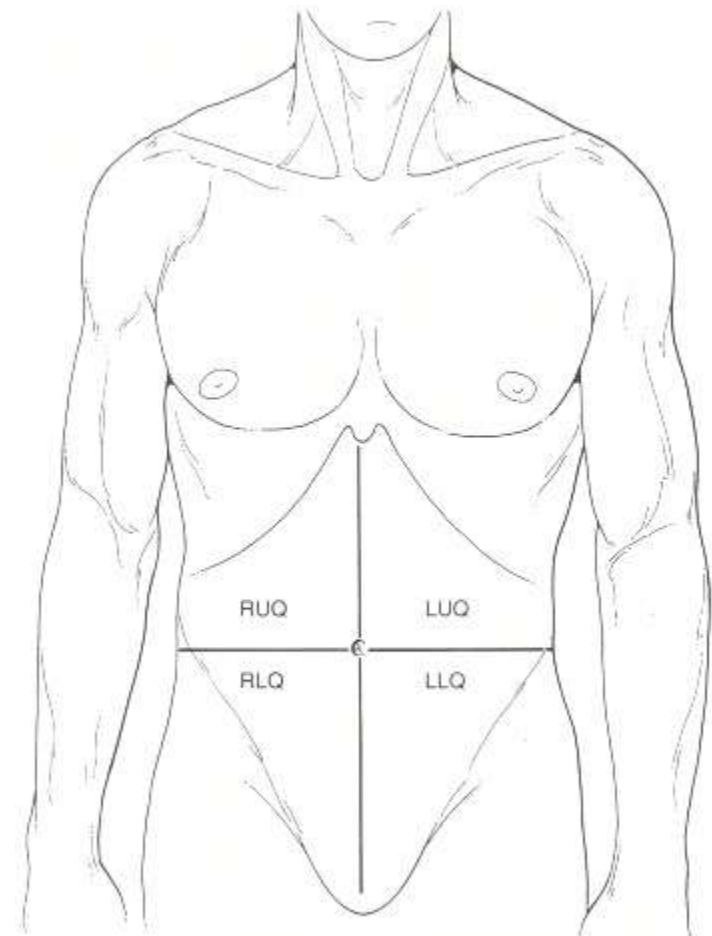
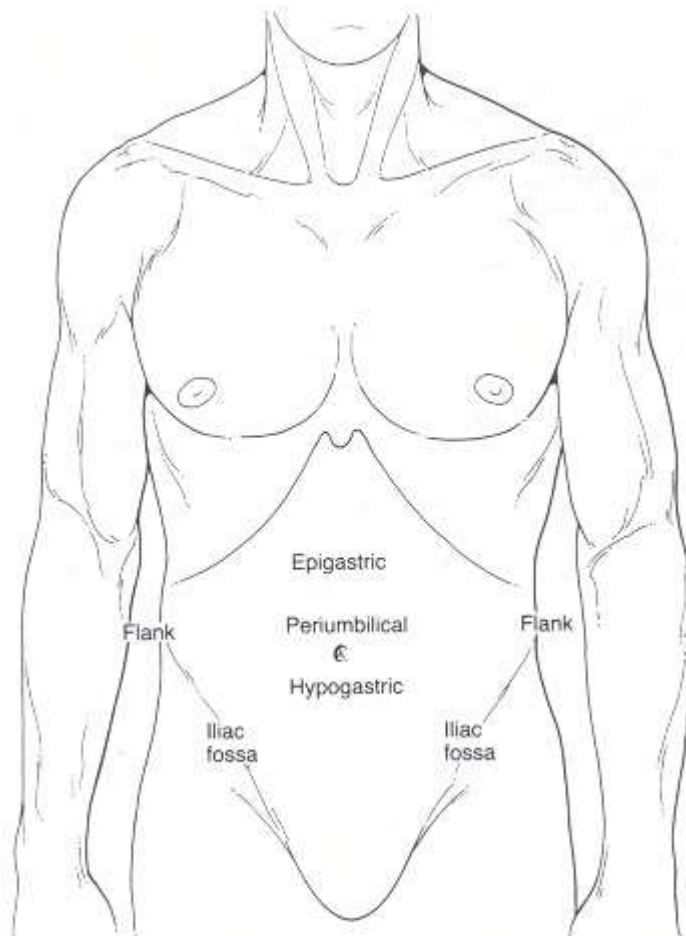


Physical examination of the patient: chest inspection

- gynaecomastia in men
- the presence of 5 or more spider naevi



Physical examination of the patient: abdominal areas and quadrants



Physical examination of the patient: abdomen inspection

- Scars
- Abdominal distension
- Focal swelling
- Asymmetry
- Dilated/prominent veins
- Visible peristalsis
- Obvious pulsation
- Skin discoloration
- Location and nature of any surgical stomas



Physical examination of the patient: abdomen auscultation

- Auscultation for bowel sounds may be carried out before percussion and palpation due to adverse effect that these procedures may have on the sound from the bowels
- Bowel sounds listen with the diaphragm of the stethoscope just for up to 30 seconds below the umbilicus (normal, 'tinkling', absent)
- High pitched or absent sounds may indicate bowel obstruction
- Absence of sounds may be also be caused by peritonitis



Physical examination of the patient: abdomen light palpation

- Gently palpate all nine areas
- Start away from known pain
- If there is pain on light palpation, try and determine if this is rebound tenderness



Physical examination of the patient: abdomen deep palpation

- Note any masses or structural abnormality
- Masses should be described in terms of site, size, shape, surface, consistency, mobility, movement with respiration, tenderness and pulsatility



Physical examination of the patient: abdomen percussion

- You should percuss any lumps or masses identified on palpation to determine their size and nature
- Percuss individual organs to help determine their size
- If the abdomen appears distended and you suspect the presence of ascites test for 'shifting dullness' and 'fluid thrill'



Instrumental methods: flat-plate film of the abdomen



The first x-ray study that the health care provider orders
when diagnosing a gastrointestinal problem

Instrumental methods: upper gastrointestinal tract radiography

- An x-ray examination of the esophagus, stomach and the duodenum using a special form of x-ray (fluoroscopy) and an orally ingested contrast material such as barium
- In addition to drinking barium, some patients are also given baking-soda crystals (similar to Alka-Seltzer) to further improve the images



Instrumental methods: lower gastrointestinal tract radiography

- An x-ray examination of the large intestine
- The examination evaluates the right or ascending colon, the transverse colon, the left or descending colon, the sigmoid colon and the rectum
- The appendix and a portion of the distal small intestine may also be included



Instrumental methods: computed tomography

When to perform CT of the GI tract

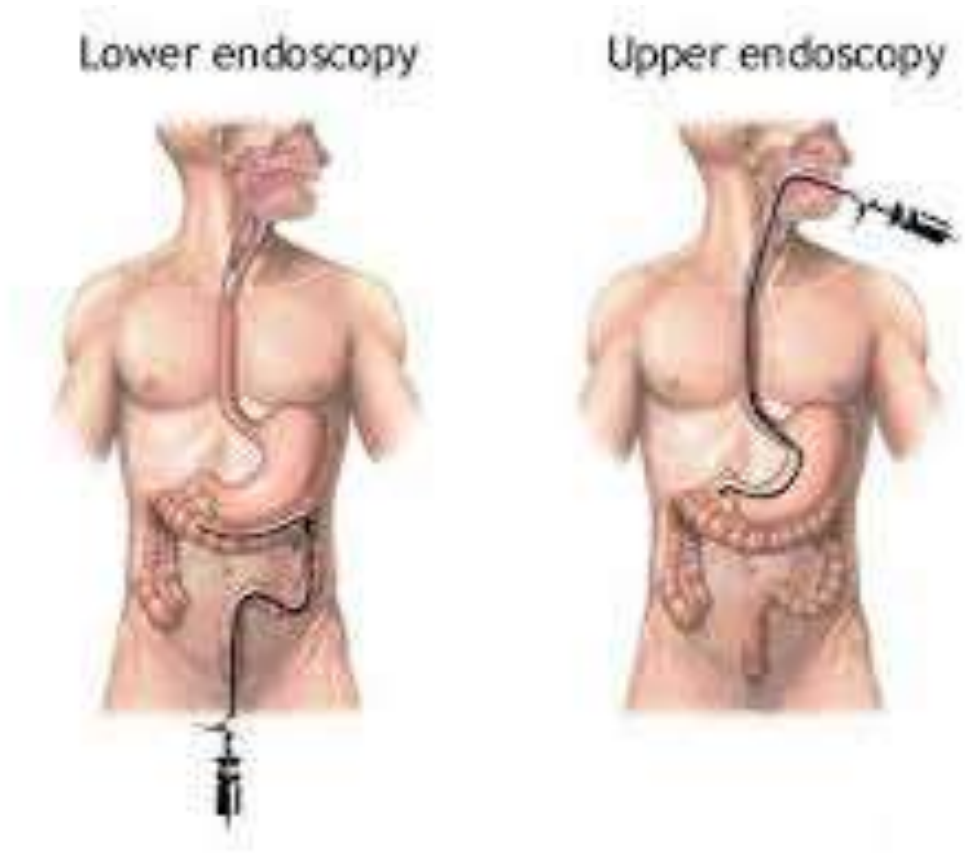
- Suspected bowel obstruction
- Suspected bowel perforation
- Abdominal pain
- Detect suspected GI malignancy
- Stage known GI malignancy



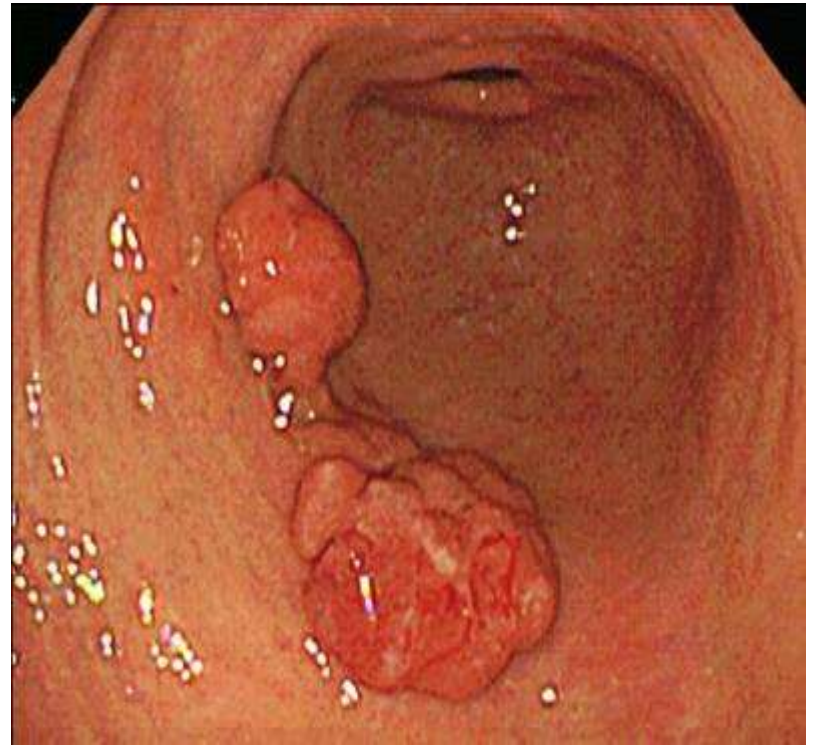
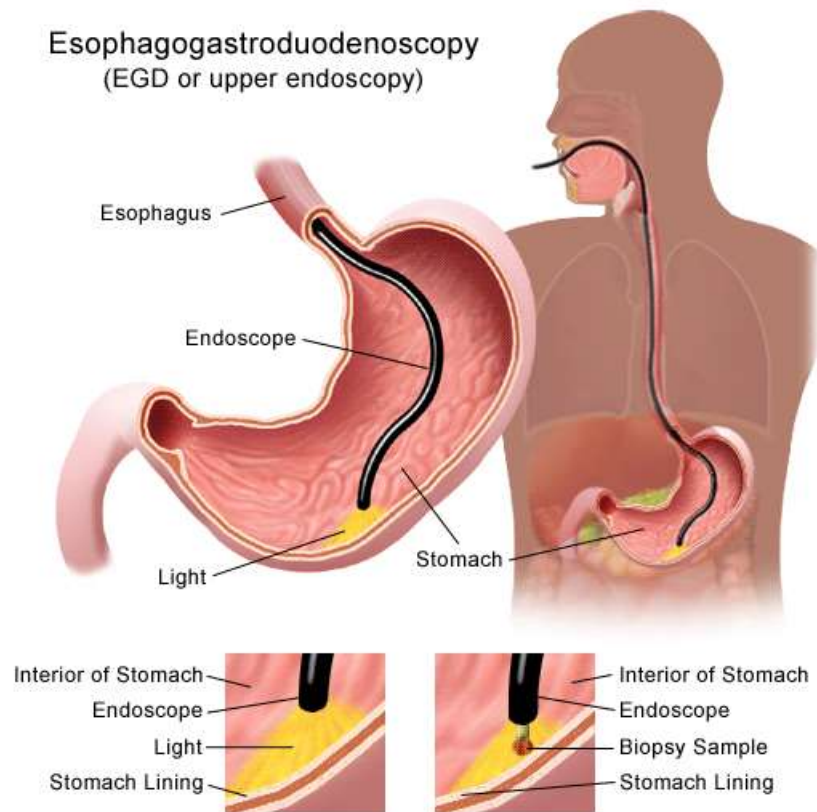
Instrumental methods: endoscopy

Direct visualization of the gastrointestinal tract by means of a flexible fiberoptic endoscope:

- Fibroesophagogastro-duodenoscopy (upper endoscopy)
- colonoscopy (lower endoscopy)

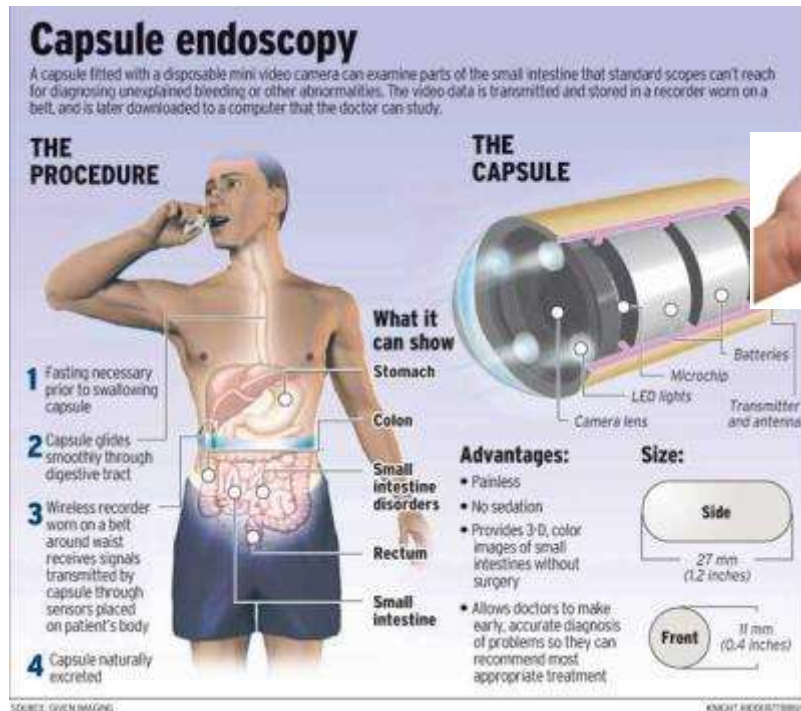


Instrumental methods: esophagogastroduodenoscopy



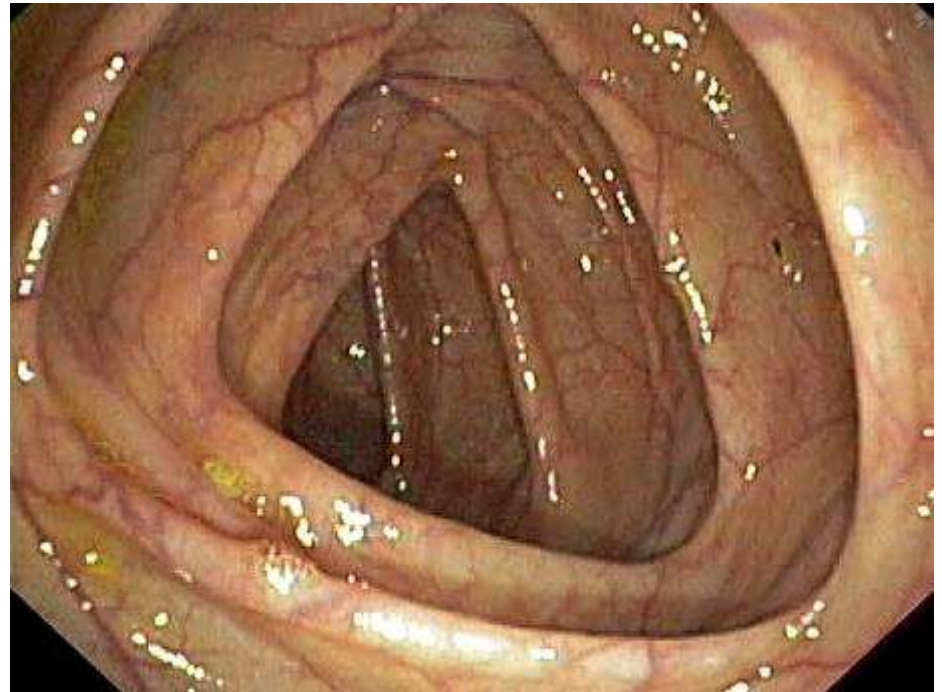
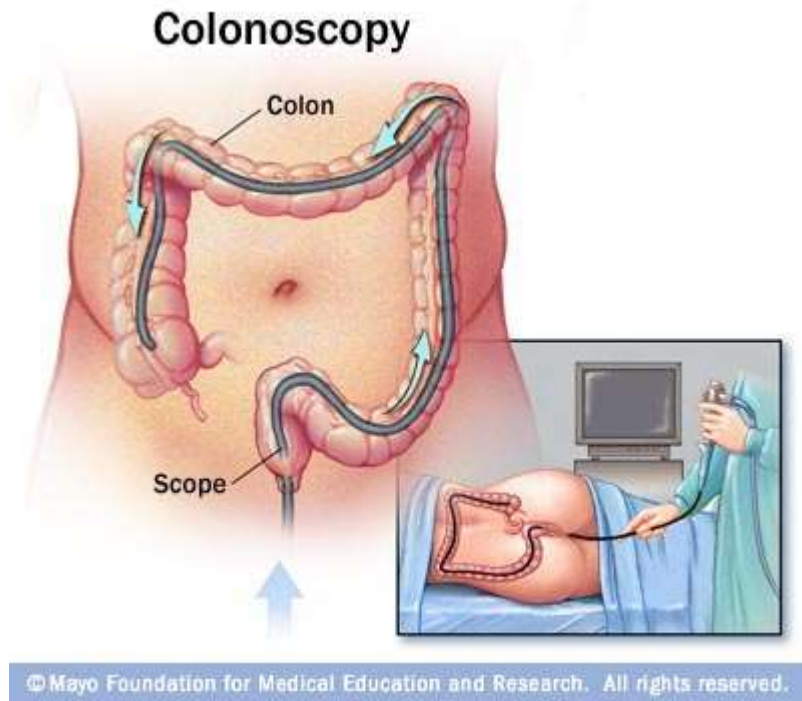
Visual examination of the esophagus, stomach, and duodenum

Instrumental methods: small bowel capsule endoscopy



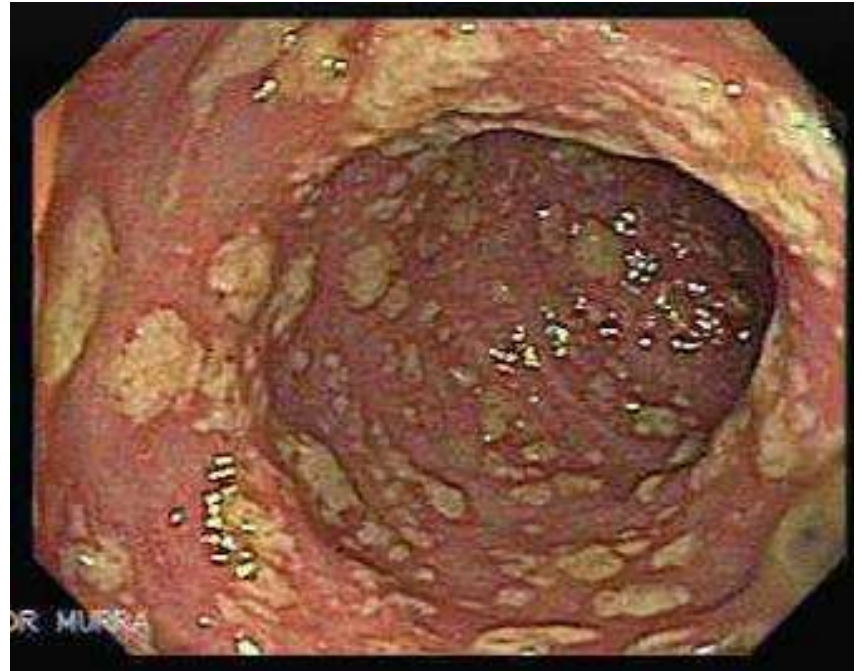
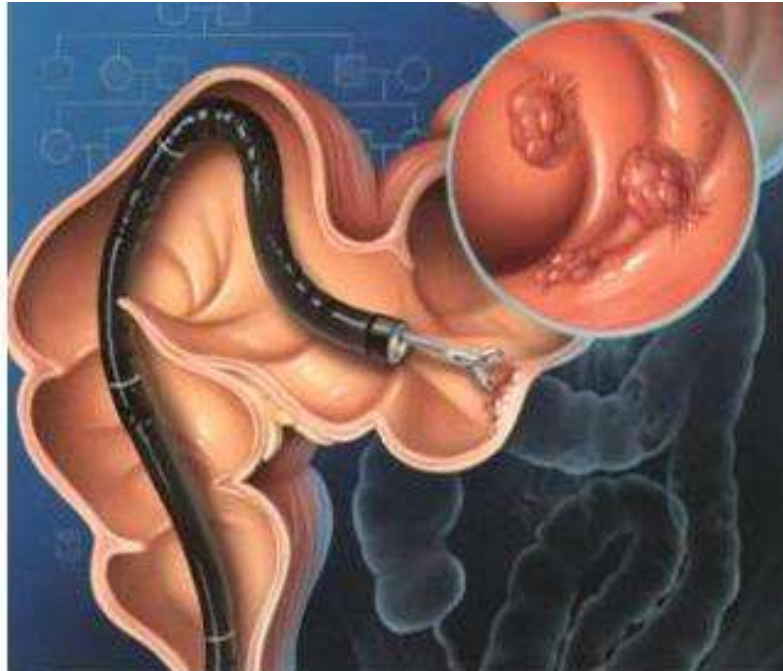
Visualization of the small intestine, application of belt with sensors

Instrumental methods: colonoscopy



Endoscopic examination of the entire large bowel

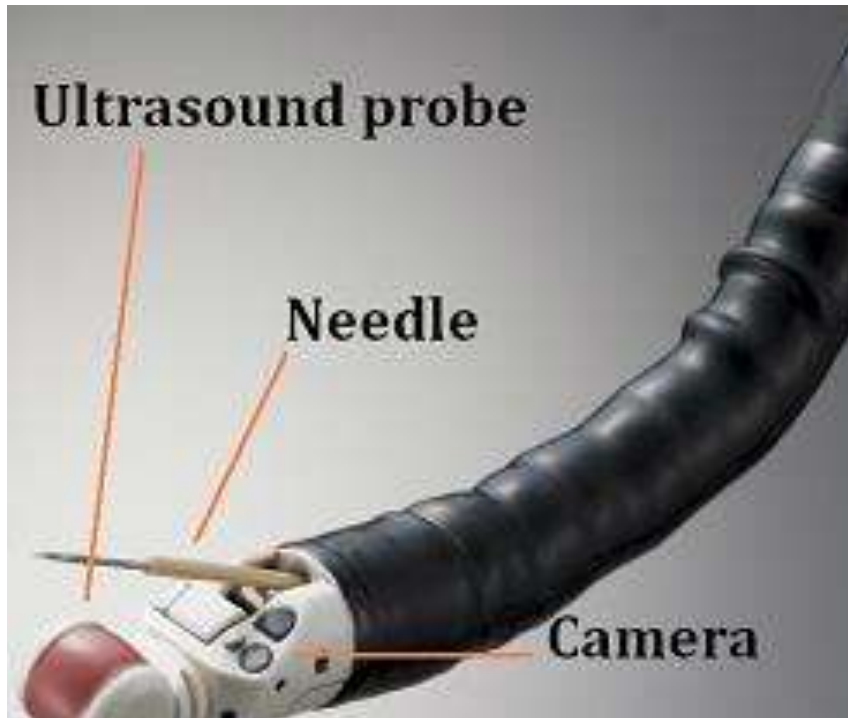
Instrumental methods: proctosigmoidoscopy



Endoscopic examination of the rectum and sigmoid colon

<http://i1090.photobucket.com/albums/i376/JenniferStone1/Colonoscopy2.jpg> <http://www.gastrointestinalatlas.com/imagenes/ColitissPseudoMembranoux4.jpg>

Instrumental methods: endoscopic ultrasonography



laboratory methods: tests

- Blood count
- Blood sugar tests
- Blood clotting factors
- Electrolytes
- Enzyme & protein blood tests
- Lipid blood tests
- C-reactive protein
- Fecal occult blood test
- Gut flora examination
- Ova and parasites exam
- *Clostridium difficile* infection test



Photo courtesy of Cepheid

laboratory methods: enzyme & protein blood tests

- Alanine Aminotransferase (ALT; also called SGPT), goal value: 5 – 50 U/L
- Aspartate Aminotransferase (AST; SGOT), goal value: 7 – 40 U/L
- Creatinine (Cr), goal value: 0.7 – 1.4 mg/dL
- Creatine Kinase (CK), goal value: 30 – 220 U/L
- Lactate dehydrogenase (LDH), goal value: 100 - 220 U/L
- Myoglobin (Mb), goal value: 30 – 90 µg/mL
- Troponin T (cTNT), goal value: 0.0 - 0.10 µg/mL

laboratory methods: lipid blood tests

- Total cholesterol. A high level can put you at increased risk of heart disease. Ideally, total cholesterol should be below 200 milligrams per deciliter (mg/dL), or 5.2 millimoles per liter (mmol/L)
- Low-density lipoprotein (LDL) cholesterol. Too much of it in blood causes the accumulation of fatty deposits (plaques) in arteries (atherosclerosis). Ideally, your LDL cholesterol level should be less than 130 mg/dL (3.4 mmol/L), and under 100 mg/dL (2.6 mmol/L) is even better
- High-density lipoprotein (HDL) cholesterol. Ideally, your HDL cholesterol level should be 60 mg/dL (1.6 mmol/L) or higher, though it's common that HDL cholesterol is higher in women than men.
- Triglycerides. High levels increase risk of heart disease. Ideally, triglyceride level should be less than 150 mg/dL (1.7 mmol/L)

laboratory methods: C-reactive protein

- CRP is a sign of inflammation somewhere in the body
- Inflammation plays a central role in the process of atherosclerosis, in which fatty deposits clog arteries
- CRP test result can be interpreted as putting heart disease risk at:
 - Low risk (less than 1.0 milligrams per liter, or mg/L)
 - Average risk (1.0 to 3.0 mg/L)
 - High risk (above 3.0 mg/L)

laboratory methods:

Fecal occult blood test

- Fecal occult blood (FOB) refers to blood in the feces that is not visibly apparent (unlike other types of blood in stool such as melena or hematochezia)
- A fecal occult blood test (FOBT) checks for hidden (occult) blood in the stool (feces)
- Newer tests look for globin, DNA, or other blood factors including transferrin, while conventional stool guaiac tests look for heme

laboratory methods: gut flora examination

- Gut flora (gut microbiota), consists of a complex community of microorganism species that live in the digestive tracts
- The gut microbiome refer to the genomes of the gut microbiota
- Gut microorganisms benefit the host by gleaning the energy from the fermentation of undigested carbohydrates and the subsequent absorption of short-chain fatty acids
- The human body carries about 100 trillion microorganisms in its intestines, a number ten times greater than the total number of human cells in the body
- Bacteria in the gut fulfill a host of useful functions for humans, including digestion of unutilized energy substrates, stimulating cell growth, repressing the growth of harmful microorganisms, training the immune system to respond only to pathogens, and defending against some diseases
- Altering the numbers of gut bacteria, for example by taking broad-spectrum antibiotics, may affect the host's health and ability to digest food

laboratory methods: ova and parasites exam

- The ova and parasite (O&P) exam is used to help diagnose the cause of prolonged diarrhea
- It is ordered to determine whether there are parasites present in the lower digestive tract and, if so, to identify them
- Since there are many other causes of diarrhea, the O&P is often ordered along with other tests, such as a stool culture, which identifies the presence of disease-causing bacteria in the stool
- O&P tests may also be ordered to monitor the effectiveness of treatment for a parasitic infection

laboratory methods: *Clostridium difficile* infection tests

- Tests to detect *Clostridium difficile* (*C. difficile*) and its toxins are used to diagnose diarrhea and other conditions and complications caused by toxin-producing *C. difficile*
- Conditions resulting from this bacterial infection include pseudomembranous colitis, in which dead tissue, fibrous protein, and numerous white blood cells form a lining over the surface of the inflamed bowel, toxic megacolon, and perforated bowel
- There are a number of tests some of them are very sensitive but take some days to complete, while other tests are rapid (several hours) but are not considered to be very sensitive or specific

laboratory methods: the evaluation of malabsorption/maldigestion

Carbohydrate malabsorption

- D-xylose absorption test (decreased)
- Disaccharidase test (decreased)
- Breath hydrogen test (increased)

Fat malabsorption

- Fecal fat determination (elevated)
- ¹⁴C-triolein breath test (decreased)

Bacterial overgrowth

- ¹⁴C-Xylose breath test (increased)

Specific disorders

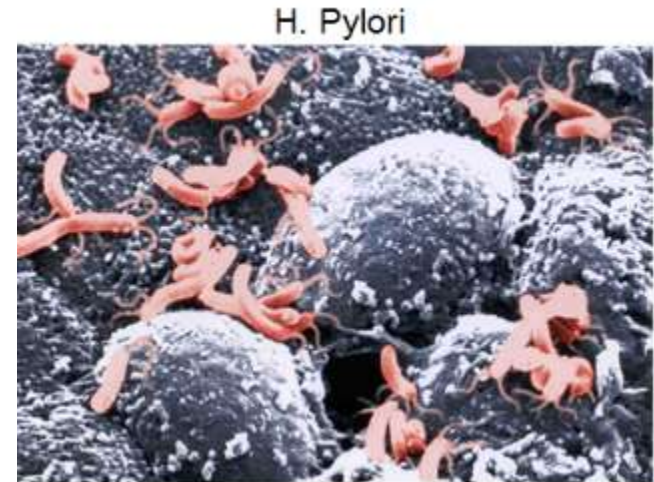
- Celiac disease (Endomysial antibody present)
- Pernicious anemia (Schilling test - absorption of vitamin B12)

Instrumental and laboratory methods: other tests

- Gastric Function Tests (Basal gastric secretion; Pentagastrin stimulation test)
- Esophageal manometry: Measures both the movement and pressures in the esophagus.
- Anorectal manometry: Detects problems with bowel movement by measuring the tone in the anal sphincter and rectal muscles.
- Esophageal 24-hour pH Monitoring: During a 24-hour period, both acid and non-acid reflux is monitored in the esophagus.
- Secretin Stimulation Test: Measures the ability of the pancreas to respond to secretin, a digestive hormone.
- Gastrointestinal Motility Studies: Exam to look at how the stomach and upper small intestinal muscles contract

Accent on diagnosis of H. Pylori

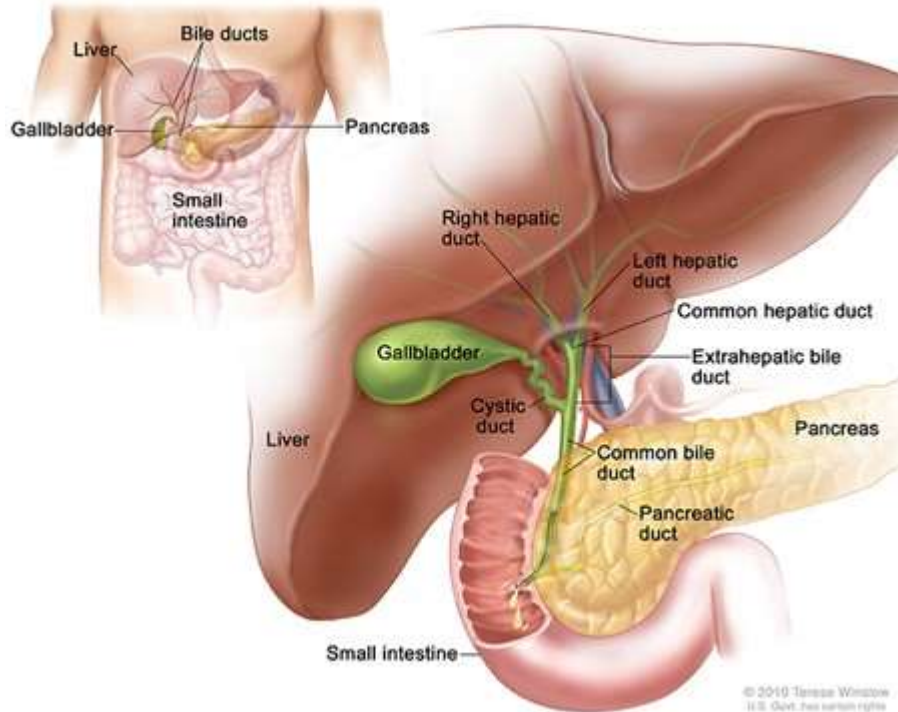
- Biopsy
 - Culture
 - Rapid urease activity tests
- 3C-breath test – gold standard
- Immunoassay for IgG antibody



Lecture 6

Approach to the Patient with diseases of
the hepatobiliary tract and pancreas

Plan of the lecture



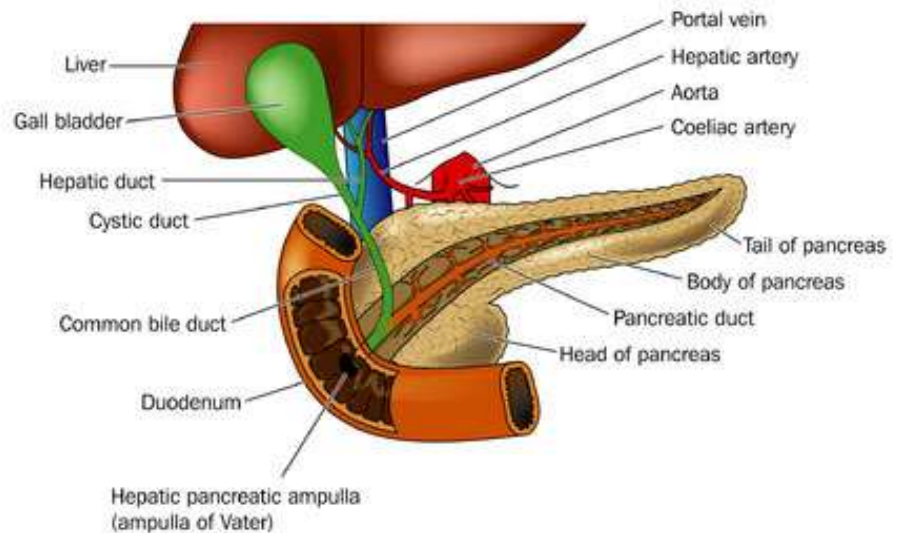
Approach to the Patient with Disease of the Hepatobiliary Tract and Pancreas

- The Hepatobiliary Tract and Pancreas components
- Interviewing of the patient
- Interviewing of the patient
- Physical examination of the patient
- Instrumental methods
- laboratory methods

The Hepatobiliary Tract and Pancreas components

The Hepatobiliary Tract and Pancreas components:

- Liver
- Biliary tract
- Gall bladder
- Pancreas
- Hepatic pancreatic ampulla



Interviewing of the patient: Good questions to get started on the core interview



- Communication skills:
- Active listening
- Empathy
- Building rapport
- Open-ended questions
- Leading questions
- Silence
- “Why” questions
- Nonverbal communication cues

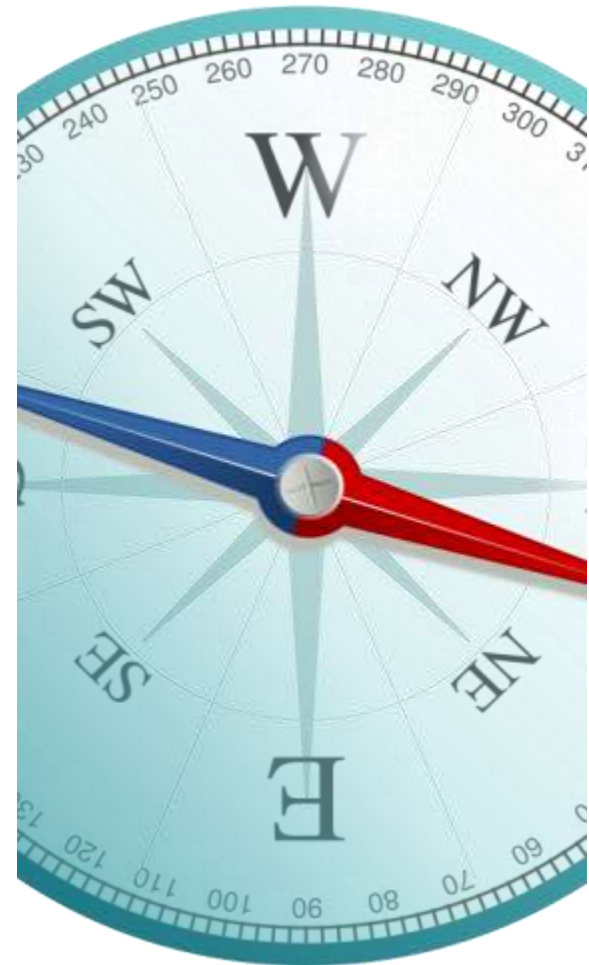
Interviewing of the patient: Good questions to get started on the core interview

- What is your chief complaint?
- Tell me why you're here today
- Tell me about your injury
- What can I do to help you?
- Explain to me your understanding of your injury



Interviewing of the patient: Patient profile

- Age
- Sex
- Race/Ethnicity
- Handedness
- Ht-Wt-BMI-Body type
- Primary language
- Barriers to learning
- Learning preference
- Unique rehabilitation goals



Interviewing of the patient: chief complaints of liver disease

- Fatigue
- Anorexia
- Disordered taste and smell
- Nausea and vomiting
- Alteration in body weight
- Pain
- Hepatomegaly
- Jaundice
- Alteration in bowel function
- Portal hypertension
- Edema and ascites
- Cholestatic pruritus
- Coagulopathy
- Bleeding
- Fever
- Hepatic encephalopathy
- Sexual dysfunction
- Muscle cramps

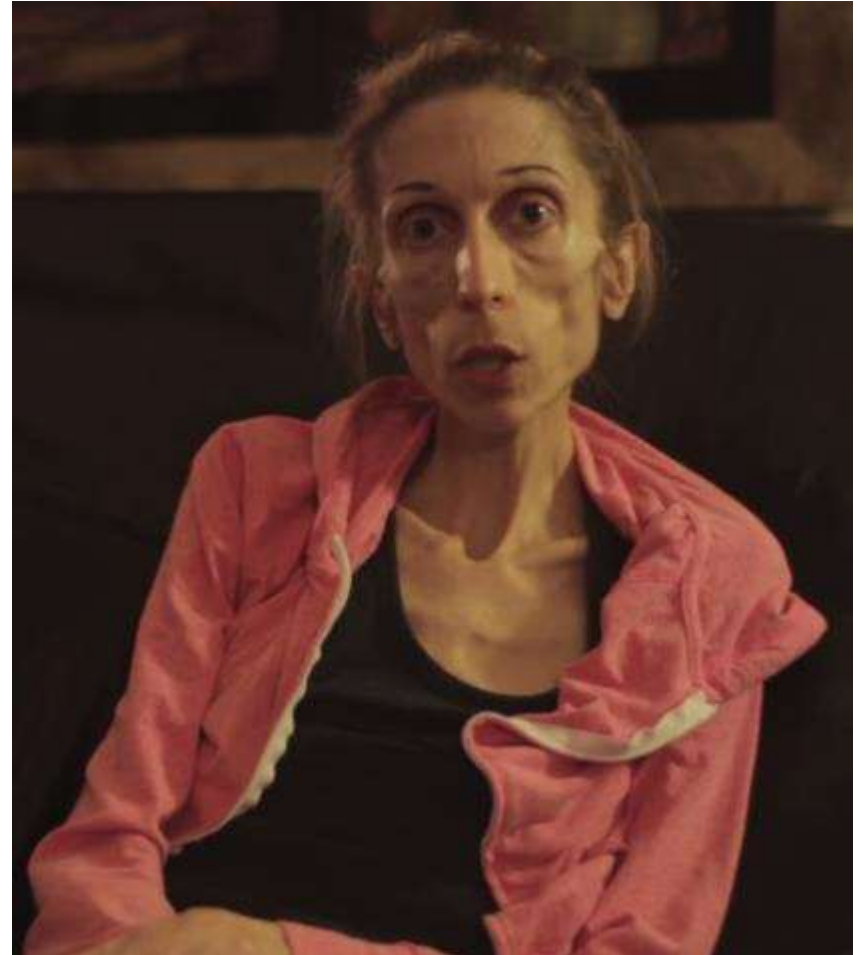
Interviewing of the patient: fatigue in liver disease

- Fatigue is one of the most common and debilitating symptoms among individuals with liver disease
- In some patients, fatigue begins several years after the diagnosis of liver disease is made and in others, it was the primary reason for seeking medical attention
- Fatigue may occur at any time of day but is most common in the morning about an hour after awakening and even little tasks become more trying and around 4 p.m., they simply must lie down to take a nap

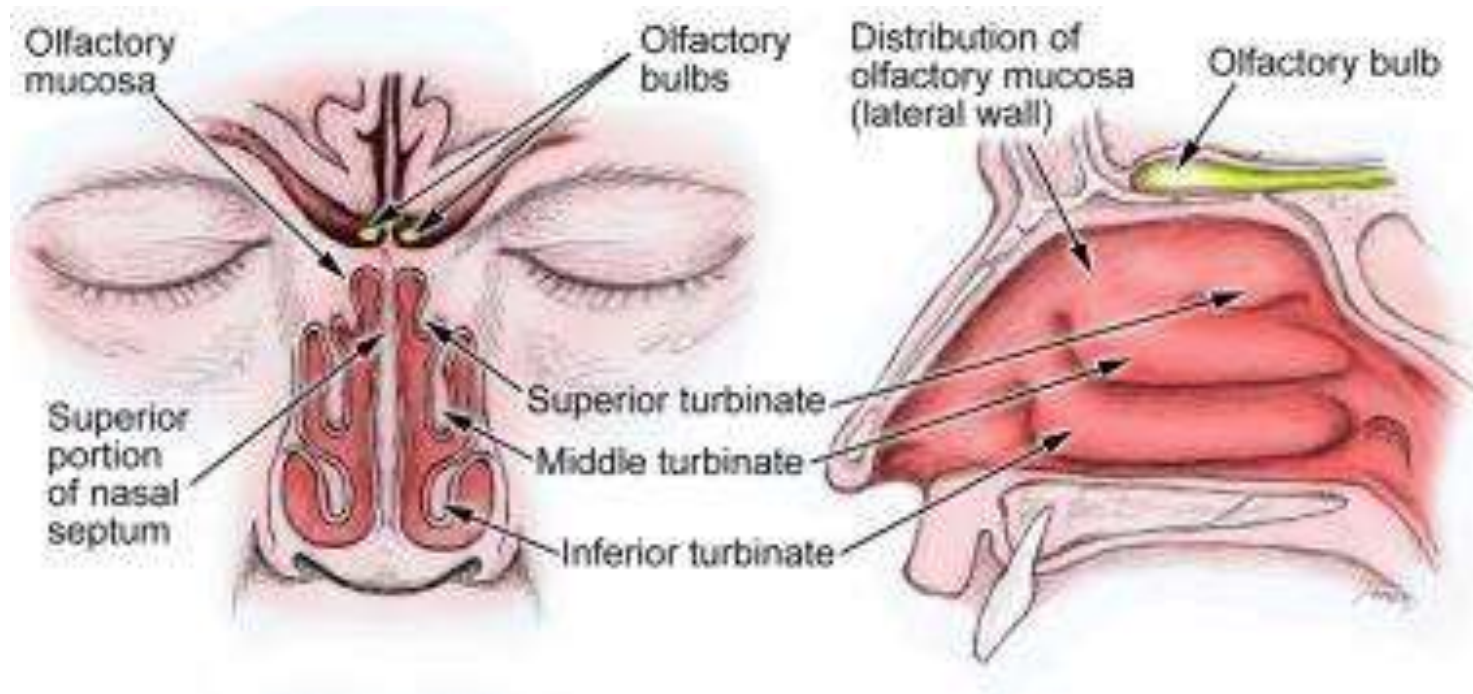


Interviewing of the patient: anorexia in liver disease

- Anorexia, is an eating disorder characterized by a low weight, fear of gaining weight, a strong desire to be thin, and food restriction
- Anorexia often begins following a severe liver disease
- The diagnosis requires a significantly low weight
- In adults the severity of anorexia is based on body mass index (BMI):
 - a BMI of greater than 17 – mild
 - a BMI of 15 to 16 - moderate
 - a BMI less than 15 – severe



Interviewing of the patient: disordered taste and smell in liver disease



- The chemical senses (taste and smell) enable us to use chemical signals to communicate with the environment and each other
- Both acute and chronic liver disease can alter smell and taste function

Interviewing of the patient: nausea and vomiting in liver disease

- Nausea is the unpleasant urge to vomit
- Vomiting is the forceful ejection of stomach contents through the mouth
- This is generally a protective mechanism to remove harmful ingested substances, but can occur from many unrelated pathologic conditions including liver disease
- Vomiting must be differentiated from regurgitation, which is the effortless movement of swallowed food contents or stomach acid from the stomach back into the mouth



Interviewing of the patient: alteration in body weight in liver disease



- Unintentional weight losses commonly seen in patients with chronic liver diseases
- Mechanisms include anorexia, early satiety due to pressure of ascites on the stomach, and accelerated metabolism

Interviewing of the patient: pain in liver disease

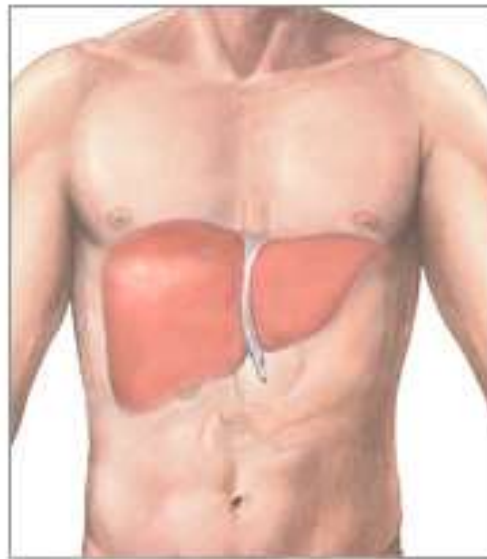
- Pain and discomfort may be felt in the upper right side of the abdomen where the liver is located
- Pain may be caused by the liver growing in size due to the accumulation of fat, acute inflammation or any injury that can expand and stretch the sensitive membrane covering the liver



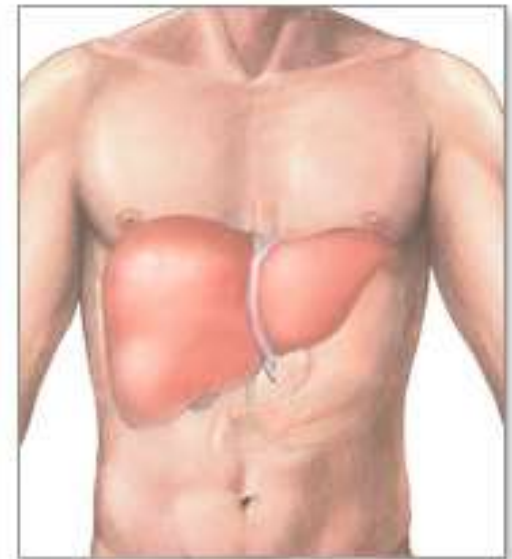
Interviewing of the patient: hepatomegaly in liver disease

- Liver disease can disrupt blood flow in the liver or cause tumors (benign or malignant) to develop, which adds to the mass of the liver
- Some of the most common causes of hepatomegaly are metastatic cancer, hepatomegaly, fatty liver disease and cirrhosis

Normal liver



Enlarged liver due to hepatomegaly



 ADAM.

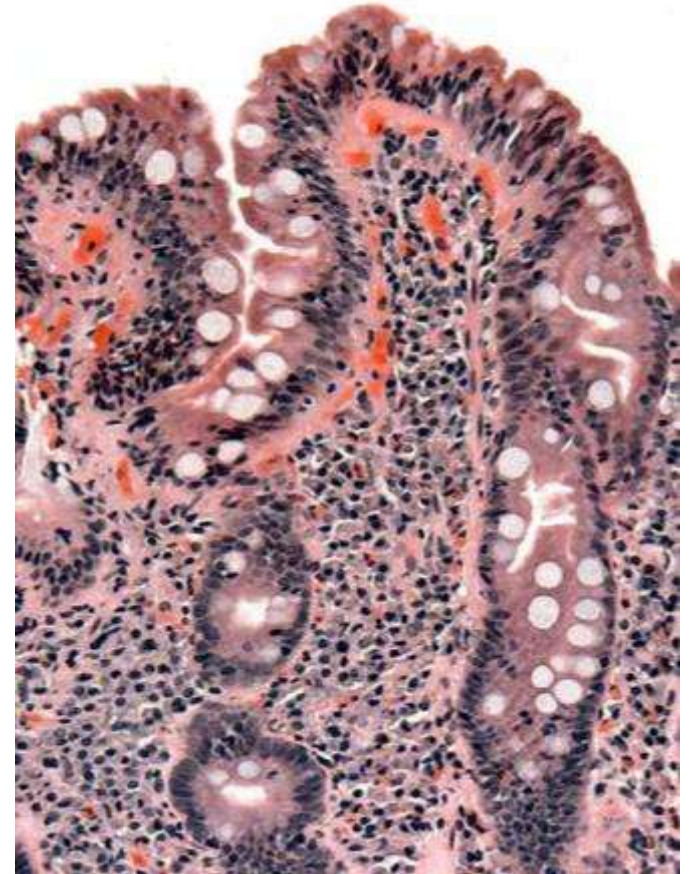
Interviewing of the patient: jaundice in liver disease

- Jaundice is indicated by a yellowing of the skin, whites of the eyes and nails
- This is caused by the damaged liver failing to adequately process bilirubin, the waste product that occurs when old red blood cells are broken down
- An excess of bilirubin accumulates in the blood and deposits in the skin, which causes the yellowish



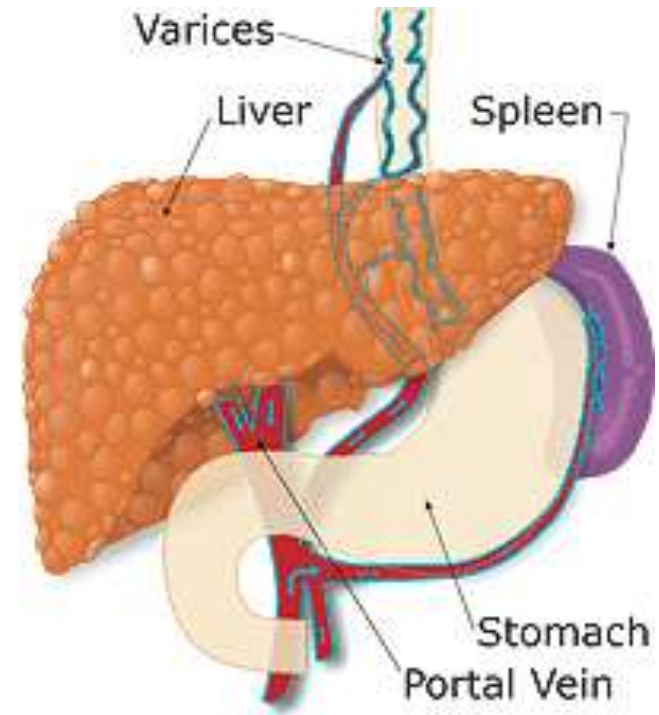
Interviewing of the patient: alteration in bowel function in liver disease

- Abnormal changes in the color of your stool can include:
 - black, tarry stools
 - clay-colored stools
 - deep red stools
 - white-colored stools
- Changes in the consistency of stool include:
 - dry stools
 - hard stools
 - mucus or fluid that leaks out around the stool
 - watery, loose stools (known as diarrhea)



Interviewing of the patient: portal hypertension in liver disease

- Portal hypertension is elevated pressure in the portal vein
- Portal hypertension is caused most often by cirrhosis, schistosomiasis (in endemic areas), or hepatic vascular abnormalities
- Consequences include esophageal varices and portosystemic encephalopathy
- Normal portal pressure is 5 to 10 mm Hg (7 to 14 cm H₂O), which exceeds inferior vena caval pressure by 4 to 5 mm Hg (portal venous gradient) and higher values are defined as portal hypertension



Interviewing of the patient: edema and ascites in liver disease

- Ascites refers to the edema or fluid retention
- Ascites is a gastroenterological term for an accumulation of fluid in the peritoneal cavity
- Ascites is also known as peritoneal cavity fluid, peritoneal fluid excess, hydroperitoneum or more archaically as abdominal dropsy
- Although most commonly due to cirrhosis, severe liver disease or metastatic cancer, its presence can portend other significant medical problems, such as Budd–Chiari syndrome



Interviewing of the patient: cholestatic pruritus in liver disease

Cholestatic pruritus is the sensation of itch due to nearly any liver disease, but the most commonly associated entities are primary biliary cirrhosis, primary sclerosing cholangitis, obstructive choledocholithiasis, carcinoma of the bile duct, cholestasis (also see drug-induced pruritus), and chronic hepatitis C viral infection and other forms of viral hepatitis



Interviewing of the patient: coagulopathy in liver disease

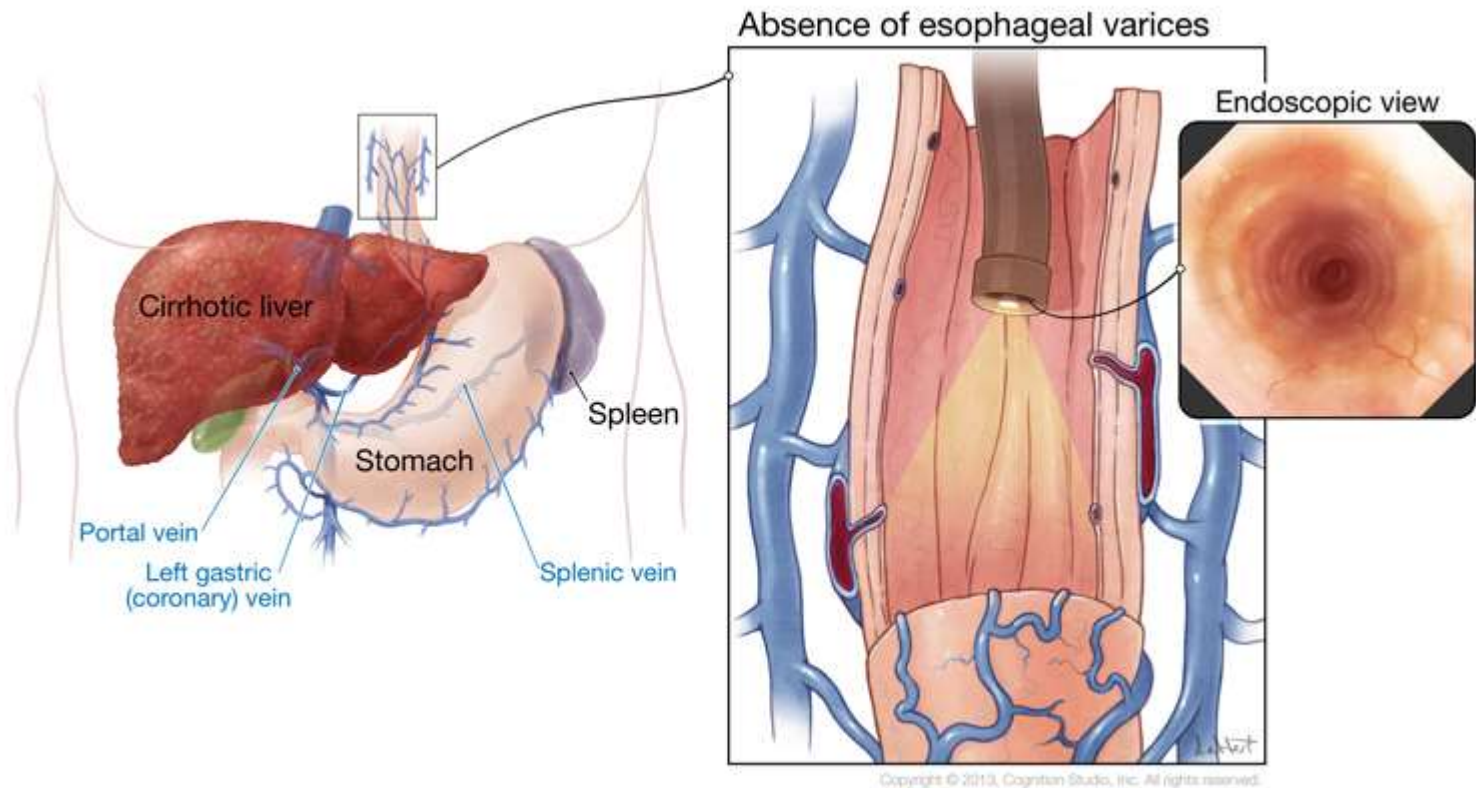
- Chronic liver disease is characterized by decreased levels of most procoagulant factors, with the notable exceptions of factor VIII and von Willebrand factor, which are elevated
- Decreased levels of the procoagulants are, however, accompanied by decreases in levels of such occurring anticoagulants as antithrombin and protein C



Interviewing of the patient: bleeding in liver disease

- In severe liver scarring (cirrhosis), the normal flow of blood through the liver may become impaired
- Blood from the intestines may then be re-routed around the liver through small vessels primarily in the stomach and esophagus
- Some of these blood vessels may become quite large and swollen; they are known as varices
- Varices can occur anywhere within the gastrointestinal tract, but occur most commonly in the esophagus and stomach
- Due to high pressure (portal hypertension) and thinning of the walls of varices, they may rupture, causing bleeding within the upper gastrointestinal tract

Interviewing of the patient: bleeding in liver disease



Interviewing of the patient: fever in liver disease

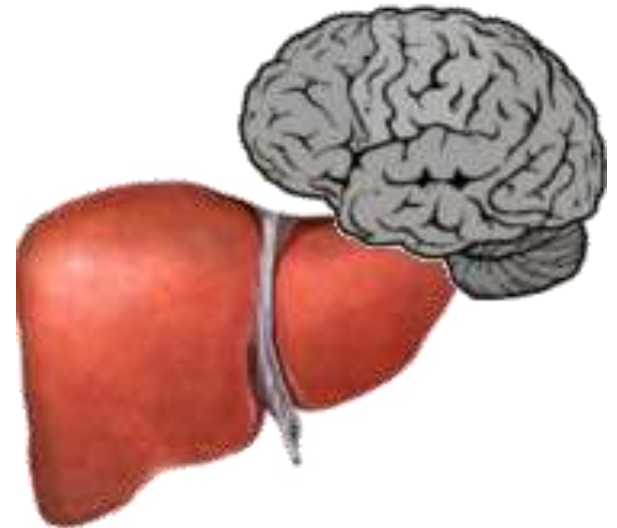
Occurrence of fever in a patient with liver diseases should suggest the following:

- Endotoxemia
- Infections
- Alcoholic hepatitis
- Hepatoma



Interviewing of the patient: hepatic encephalopathy in liver disease

- Hepatic encephalopathy refers to a decline in brain function that occurs as a result of toxic substances (ammonia, free fatty acids, mercaptans and false neurotransmitters) accumulating in the brain because the liver is no longer able to effectively eliminate them
- This complication of cirrhosis can lead to symptoms such as confusion, loss of short-term memory and even loss of consciousness
- In the advanced stages it is called hepatic coma or coma hepaticum
- Hepatic encephalopathy may ultimately lead to death
- Hepatic encephalopathy is reversible with treatment



Interviewing of the patient: sexual dysfunction in liver disease



Any male or female with chronic liver disease is at risk for experiencing sexual dysfunction

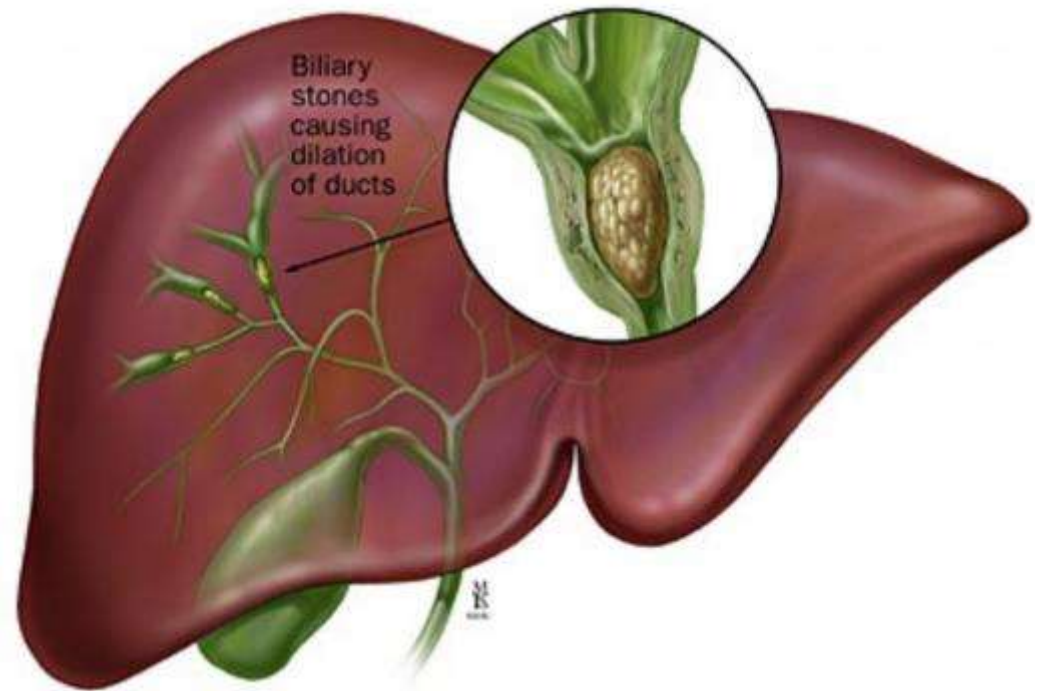
Interviewing of the patient: muscle cramps in liver disease



- Muscle cramps are common in patients with liver disease and adversely influence quality of life
- The exact mechanisms by which they occur remain unclear, although a number of pathophysiological events unique to liver disease may contribute
- Clinical studies have identified alterations in 3 areas: nerve function, energy metabolism, and plasma volume/electrolytes

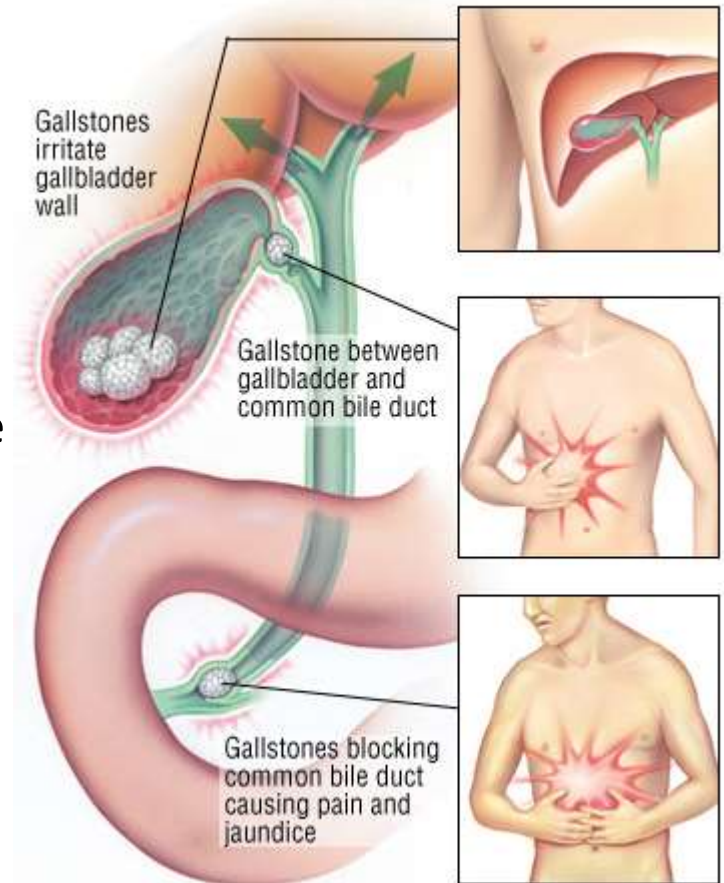
Interviewing of the patient: chief complaints in biliary disease

- Pain
- Jaundice
- Pruritus
- Fatigue
- Weight loss
- Gallstones and Bile Duct Stones
- Miscellaneous



Interviewing of the patient: pain in biliary disease

- The upper abdominal penetrating or tightness pain, typically severe and located in the epigastrium
- The pain may develop suddenly, last for 15 minutes to several hours, and then resolve suddenly
- The pain is caused by an obstruction to the flow of bile, with distension of the biliary lumen, and is clinically similar to when the obstruction occurs at the cystic duct or at another level of the common bile duct
- As noxious visceral stimuli become more intense, referred pain may be experienced in the posterior scapula or right shoulder area and be accompanied by nausea and vomiting



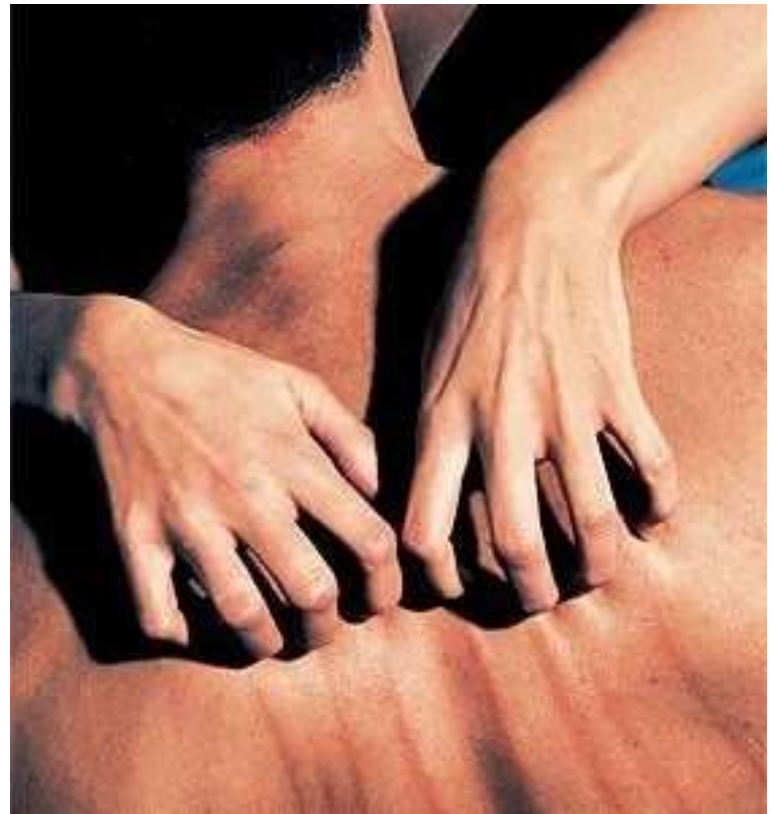
Interviewing of the patient: jaundice in biliary disease

- Bilirubin metabolism and transport principally are handled by the hepatobiliary tract
- A yellow discoloration of the skin begins to appear when serum bilirubin rises above 3 mg/dL, and the yellow discoloration is termed jaundice
- Abnormalities leading to jaundice may occur in various phases of the process



Interviewing of the patient: pruritus in biliary disease

- Itching is an unpleasant sensation in the skin associated with a strong desire to scratch
- While several causes exist, itching is associated with cholestasis and may become the patient's most bothersome symptom
- Itching may appear first in the hands and feet, but it usually becomes generalized and typically is worse at night
- Itching does not distinguish the cause of cholestasis as hepatic or biliary



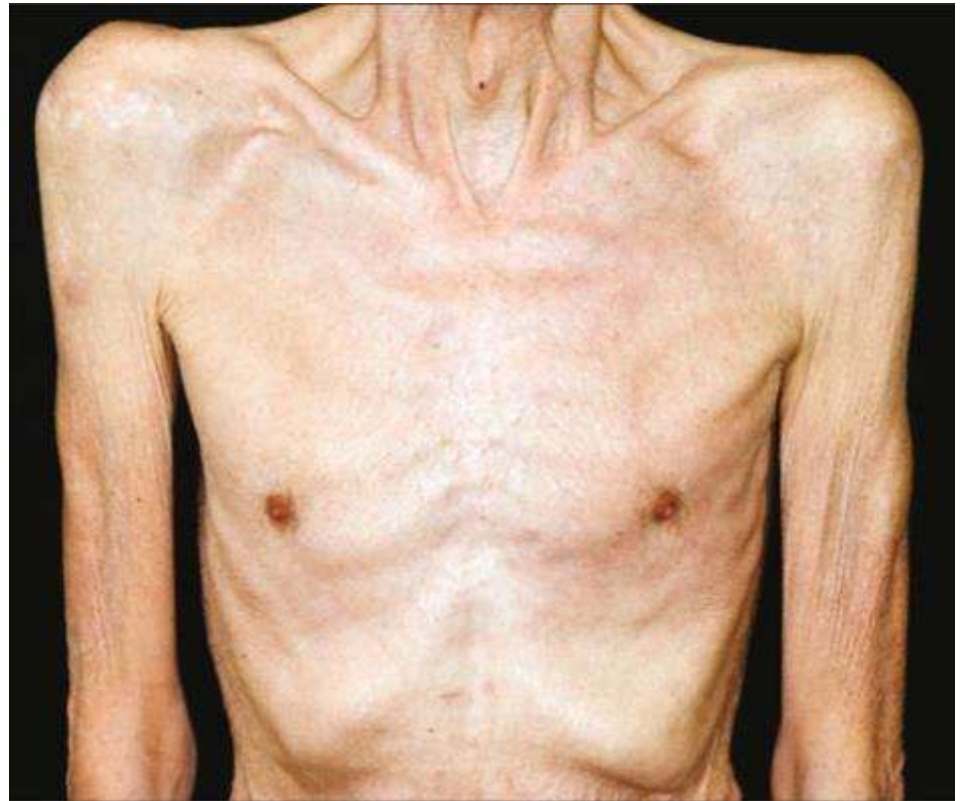
Interviewing of the patient: fatigue in biliary disease

The insidious onset of fatigue, followed by pruritus and then jaundice, is observed to varying degrees in diseases of the intrahepatic bile ducts, such as primary biliary cirrhosis, primary sclerosing cholangitis, and vanishing bile duct syndrome



Interviewing of the patient: weight loss in biliary disease

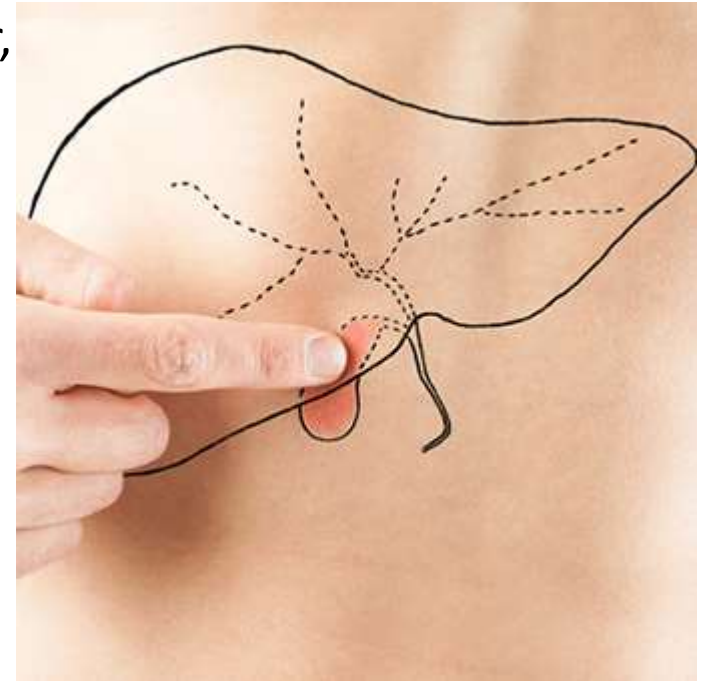
- A history of weight loss is associated with more serious diseases of the biliary tract
- The weight loss may be caused by inadequate nutrient intake (e.g., anorexia) or malabsorption of fats (e.g., a paucity of bile in cholestatic diseases or prolonged biliary obstruction)



Interviewing of the patient: gallstones and bile duct stones in biliary disease

Nature:

- Gallstones, which are created in the gallbladder, form when substances in the bile create hard, crystal-like particles
- Cholesterol stones (80%), as the name implies, are made of cholesterol and appear light in color and eighty percent of gallstones are formed this way
- Pigment stones (20%) are small, dark stones made of bilirubin and calcium salts that are found in bile
- Risk factors for pigment stones include cirrhosis of the liver, biliary tract infections, hereditary blood cell disorders (such as sickle cell anemia)
- Bile duct stones are gallbladder stones that have become lodged in the bile duct



Interviewing of the patient: miscellaneous in biliary disease

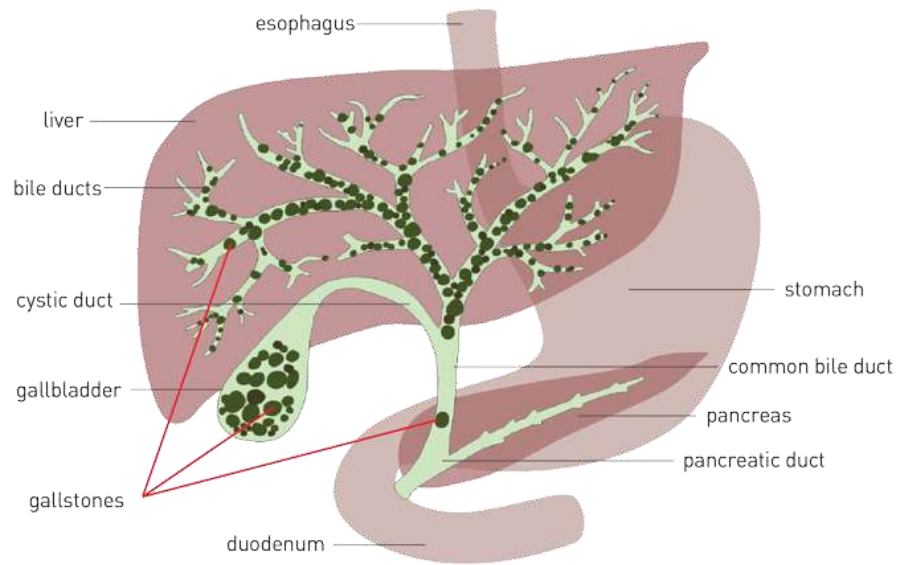


Other symptoms, including fatty food intolerance, gas, bloating, and dyspepsia, do not reliably indicate the presence of biliary tract disease

Interviewing of the patient: gallstones and bile duct stones in biliary disease

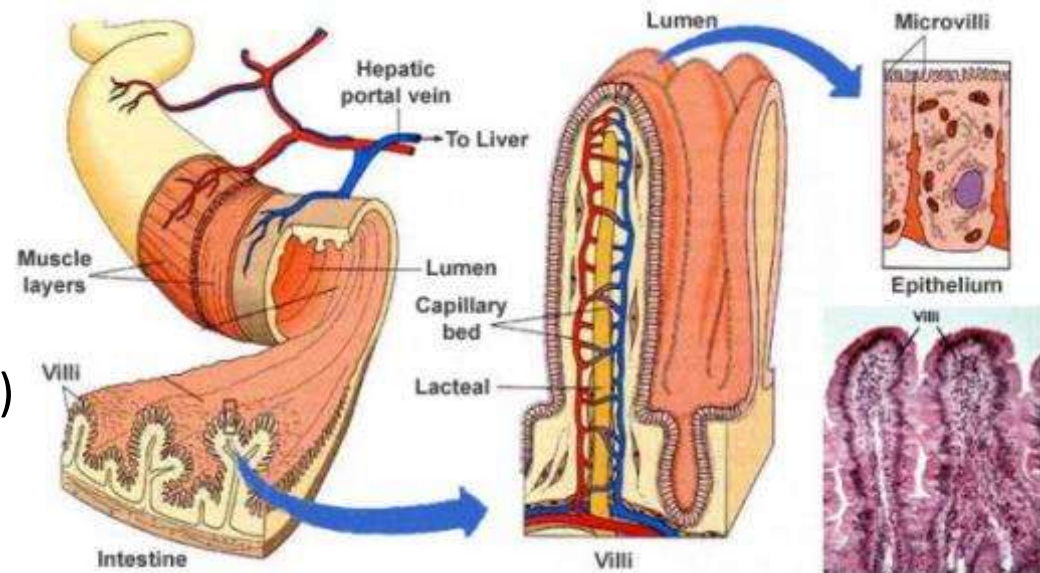
Symptoms:

- Acute pain, possibly very severe, that occurs very suddenly (pain may last a few minutes, or many hours; pain is usually located behind your breastbone, but may occur in the upper right abdominal area; pain between shoulder-blades is another symptom of gallstones)
- Chills and fever
- Jaundice
- Nausea and vomiting

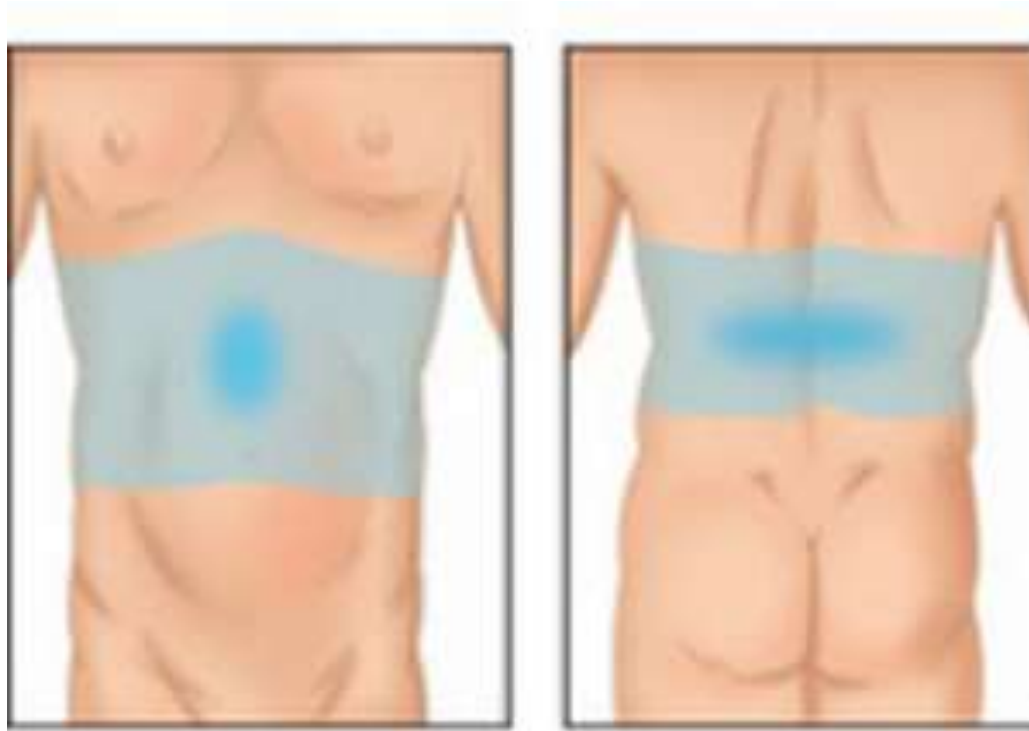


Interviewing of the patient: chief complaints in pancreatic disease

- Upper abdominal pain
- Nausea and vomiting
- Malabsorption
- Diabetes
- Losing weight without trying
- Oily, smelly stools (steatorrhea)
- Tenderness when touching the abdomen
- Miscellaneous



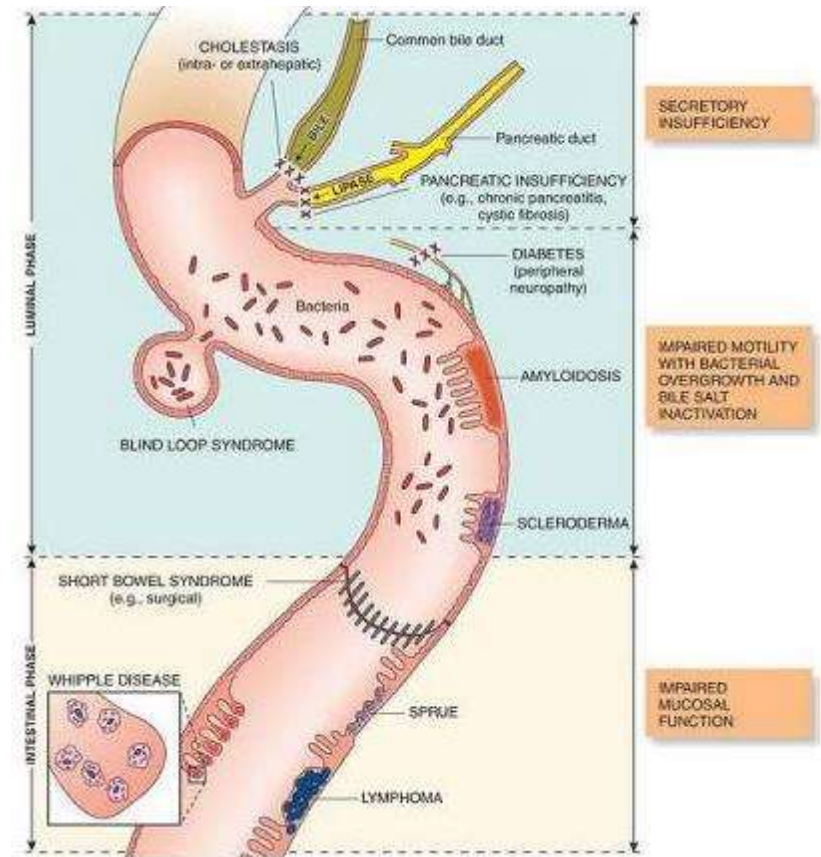
Interviewing of the patient: pain in pancreatic disease



- Upper abdominal pain radiates to left back and feels worse after eating and when patient is lying down
- Pain may last for a few minutes to several hours at a time

Interviewing of the patient: malabsorption in pancreatic disease

- Malabsorption is a state arising from abnormality in absorption of food nutrients across the gastrointestinal (GI) tract
- Impairment can be of single or multiple nutrients depending on the abnormality
- This may lead to malnutrition and a variety of anaemias
- Normally the human gastrointestinal tract digests and absorbs dietary nutrients with remarkable efficiency



Interviewing of the patient: diabetes in pancreatic disease

- The pancreas has a considerable reserve of islet beta cells, and need to excise 70–90% from healthy condition before they will develop diabetes
- Extensive pancreatic damage (severe cases of acute pancreatitis, chronic pancreatitis, pancreatic fibrosis (due for example to iron overload), following surgical excision of the pancreas, pancreatic carcinoma) is needed to cause diabetes
- Pancreatic diabetes results in loss of both insulin and pancreatic glucagon, diabetic ketoacidosis is rare, and patients are sensitive to the action of insulin.

Interviewing of the patient: steatorrhea in pancreatic disease

- Steatorrhea (steatorrhoea) is the presence of excess fat in feces
- Stools may also float due to excess gas, have an oily appearance and can be especially foul-smelling
- An oily anal leakage or some level of fecal incontinence may occur
- There is increased fat excretion, which can be measured by determining the fecal fat level
- The definition of how much fecal fat constitutes steatorrhea has not been standardized



Interviewing of the patient: Chief complaints’ “red flags”

- Fever
- Jaundice
- Acute diarrhea
- Persistent constipation
- Coagulopathy
- Bleeding
- Vomiting blood
- Hepatic encephalopathy
- Severe tenderness of the belly



Interviewing of the patient: specific questions for set of chief complaints

Each of chief complaints will prompt a series of specific questions that will help arrive at a preliminary single diagnosis, or a group of different diagnoses



Interviewing of the patient: example of specific questions in chief complaint

- Character
- Location
- Severity
- Timing
- Duration
- Radiation
- Provocation
- Relieving conditions
- When did it first start?
- How often does it occur?
- Is appetite good or has it changed?
- What brought it on?
- Were there associated symptoms
- Is it becoming more frequent with time?
- Are the symptoms lasting longer?
- How the symptoms relate to food intake?

Interviewing of the patient: past medical history

In a medical encounter, a past medical history (abbreviated PMH), is the total sum of a patient's health status prior to the presenting problem

The image shows a close-up of a medical form. The section 'Past Medical History' is highlighted. It includes a 'Cardiac' subsection with radio button options: None, Unknown, Angina, Arrhythmia, Cardiomyopathy, CHF, Congenital, Implanted Defib, and Other. To the right, there are more radio button options: None, Unknown, Abdominal, Heart, Lung, and Neurological. Below the 'Past Medical History' section, the 'Chronic Illnesses' section is partially visible, with 'Hypertension/Renal' and 'Intestinal' listed. A black pen is resting diagonally across the form.

Interviewing of the patient: prior or current treatment

- Medications
- Surgery
- Injections
- Chiropractic
- Exercise/PT (Physical Therapy)
- ER (Emergency Room)
- Massage therapy



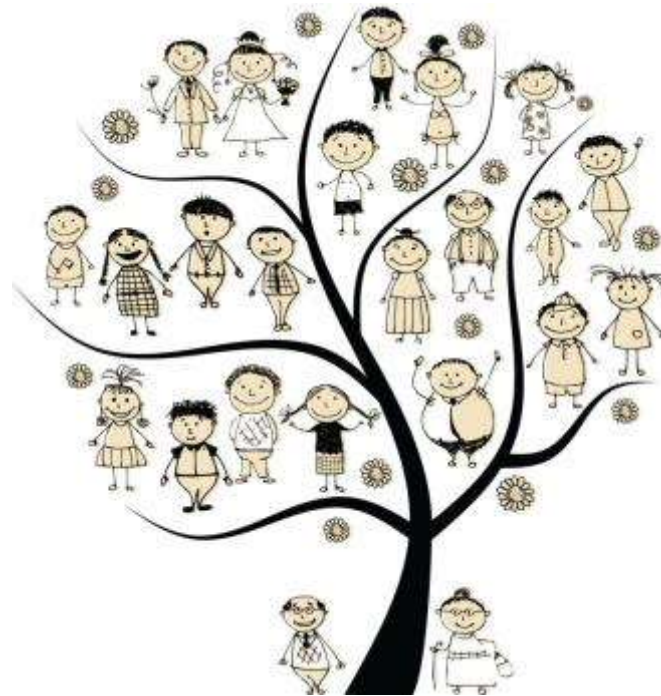
Interviewing of the patient: previous treatment and present status

- Previous Treatment
 - What?
 - Where?
 - When?
 - By whom?
- Present Status
 - Better vs. same vs. worse



Interviewing of the patient: family history and genetic risk

- Certain gastrointestinal, liver, hepatobiliary and pancreas illnesses may occur in more than one member of a family
- The physician will inquire about the health of the patient's parents, brothers, sisters and children



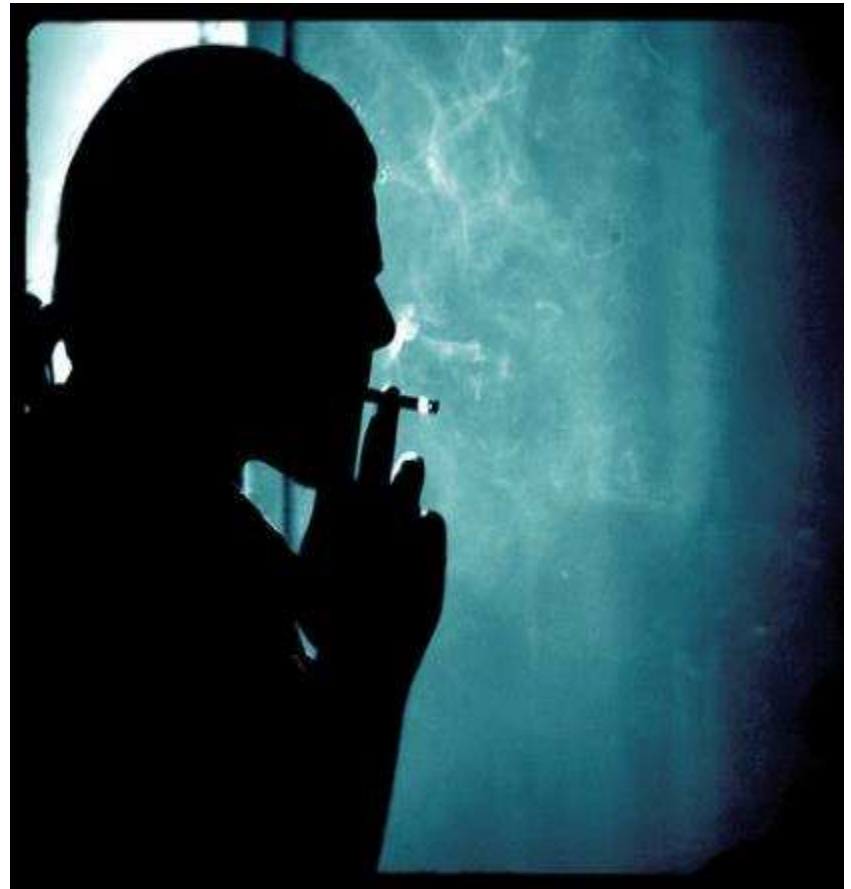
Interviewing of the patient: diet history

- A diet history is important when assessing gastrointestinal, liver, hepatobiliary and pancreas illnesses
- Many conditions manifest themselves as a result of alterations in dietary intake and absorption of nutrients



Interviewing of the patient: social history

- High-risk behaviors
 - Alcohol, tobacco, or drug abuse
 - Depression
 - Violence/abuse
 - Diet
 - Anorexia/bulimia
 - Sedentary lifestyle
- Signs of any of the above behaviors may warrant referral to a secondary provider



Interviewing of the patient: why take a medical history?

- Up 90% of conditions can be accurately diagnosed or recognized by conducting a thorough medical history and listening carefully to the patient's response(s)
- Determines the necessary tests and measures you should prioritize for your objective examination



Interviewing of the patient: review of systems

- The "laundry list" of symptoms related to various organs of the body
- A series of questions helps seek out information that the patient may have neglected to provide the physician
- Review of systems helps to identify the patient's problem, or exclude different parts of the differential diagnosis



Interviewing of the patient: systemic enquiry

- General: fever, weight loss, loss of appetite, lethargy
- Respiratory and cardiovascular systems: shortness of breath, cough, hemoptysis, wheeze, chest pain
- Genito-urinary system: dysuria (pain on passing urine), frequency, terminal dribbling, urethral discharge
- Gynecological system: pelvic pain, vaginal bleeding, vaginal discharge, LMP
- Neurological system: headaches, dizziness, loss of consciousness, fits, faints, funny turns, numbness, tingling, weakness, problems speaking, change in vision

Interviewing of the patient: Liver, Hepatobiliary and Pancreas Quality of Life Indexes

- The Liver, Hepatobiliary and Pancreas of Life Indexes are a questionnaires which measures Quality of Life these types of patients
- Indexes are a multidimensional constructs with several dimensions: emotional or psychological well being, physical functioning, social functioning, and symptoms of the disease and treatment
- A single item is also included that identifies perceived change in health, making the Indexes a useful indicators for change in Liver, Hepatobiliary and Pancreas Quality of Life Indexes over time and treatment

Physical examination of the patient: from general inspection to abdomen examination

- General inspection from the end of the bed
- General examination of:
 - Hands / pulse
 - Face
 - Lymph nodes
- Examination of the abdomen
 - Inspection
 - Palpation
 - Percussion
 - Auscultation



Physical examination of the patient: positioning

Step	Position
Inspection	Supine, head and knees supported
Auscultation	Supine, head and knees supported
Palpation	Supine, head and knees supported
Percussion	Supine, head and knees supported
Check for ascites	Supine, may need to roll patient for shifting dullness
Rectal examination	Left lateral decubitus
Inguinal examination	Standing

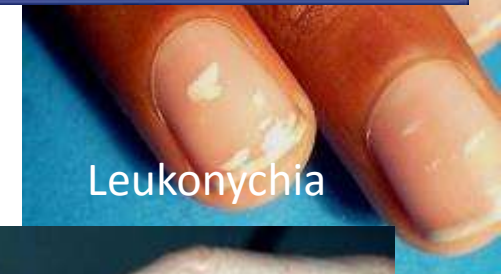
Physical examination of the patient: general inspection

- Whether patient is comfortable at rest
- Do patient appears to be tachypnoeic
- Are there any obvious patient' skin color changes
- Are there any obvious medical appliances around the bed (such as patient controlled analgesia)
- Are there any medications around (although this is unlikely as all medications should be in a locked cupboard)



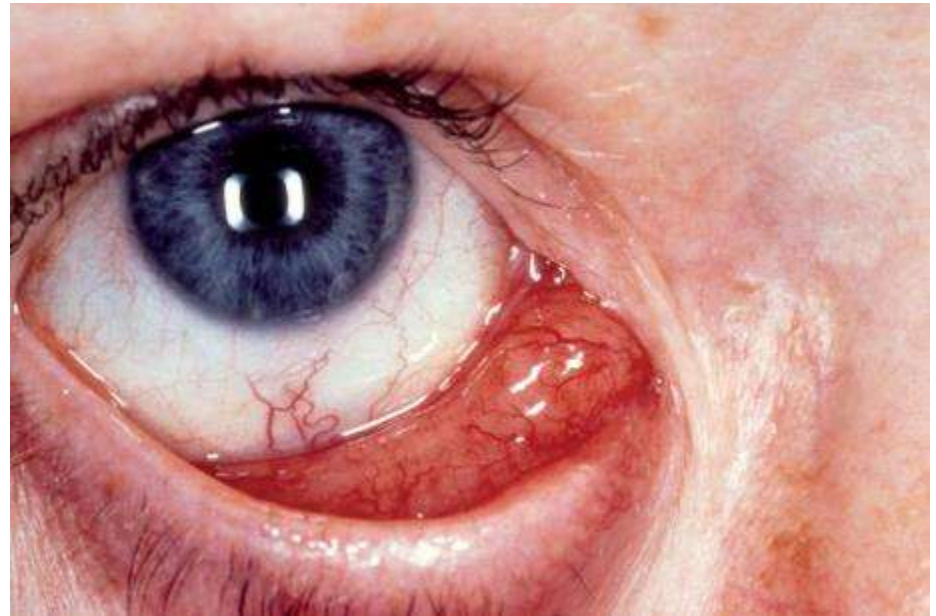
Physical examination of the patient: hands inspection

- Temperature
- Skin turgor for hydration
- Koilonychias
- Leukonychia
- Nail clubbing
- Palmar erythema
- Nicotine staining
- Dupuytren's contracture
- Peripheral cyanosis
- radial pulse



Physical examination of the patient: face inspection

- Pale conjunctiva of anaemia
- Yellow sclera of jaundice
- Changes to the tongue e.g. glossitis, macroglossia, ulcers, candidiasis



Physical examination of the patient: neck inspection

- Palpate for enlarged lymph nodes, first from the front, then back/right
- A palpable enlarged supraclavicular (Virchow's) node is known as Troisier's Sign which drains the thoracic duct, enlargement of this node may suggest metastatic deposits from a malignancy in any of these areas

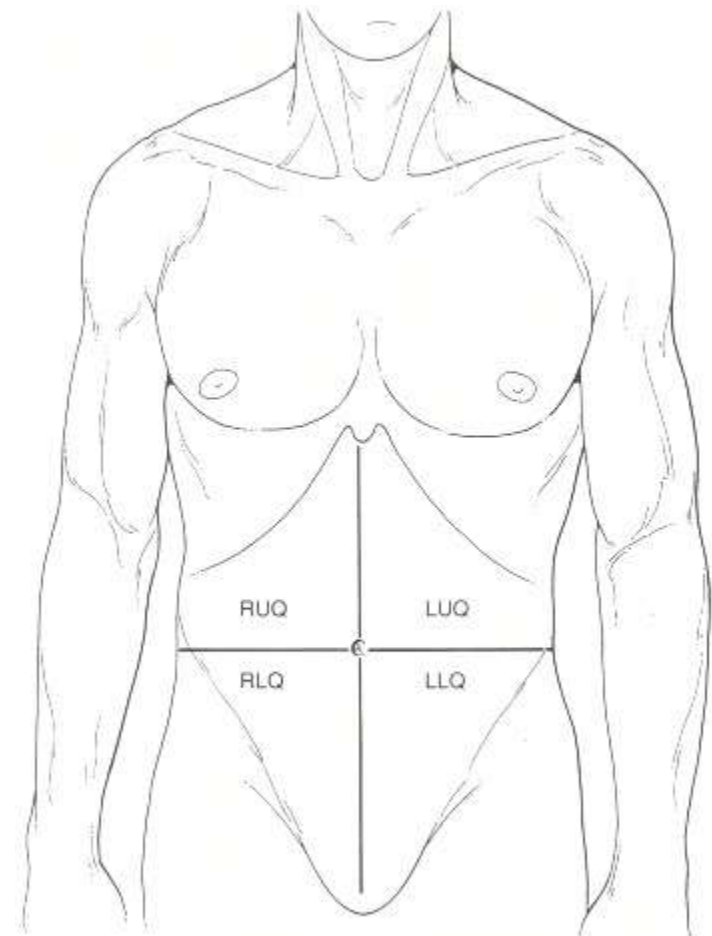
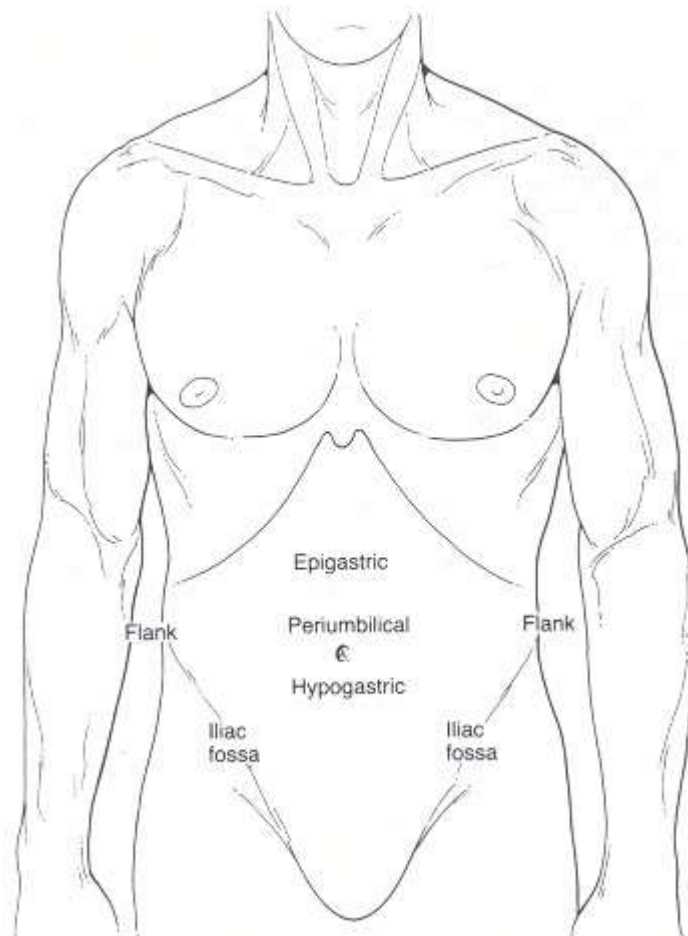


Physical examination of the patient: chest inspection

- gynaecomastia in men
- the presence of 5 or more spider naevi



Physical examination of the patient: abdominal areas and quadrants



Physical examination of the patient: abdomen inspection

- Scars
- Abdominal distension
- Focal swelling
- Asymmetry
- dilated/prominent veins
- Visible peristalsis
- Obvious pulsation
- Skin discolouration
- Location and nature of any surgical stomas



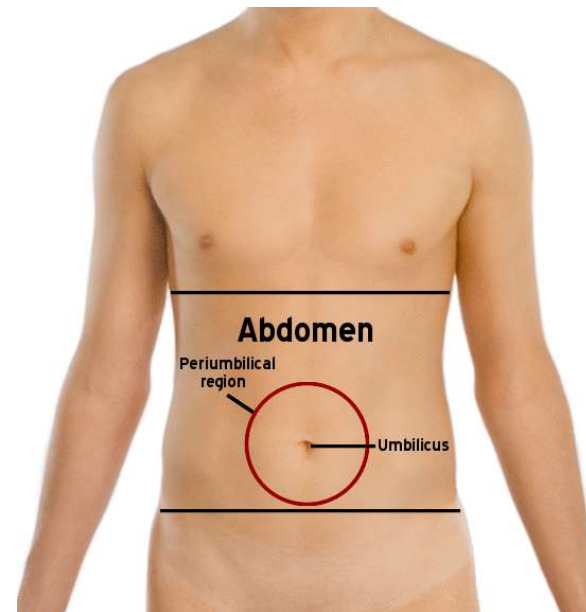
Physical examination of the patient: abdomen auscultation

- Auscultation for bowel sounds may be carried out before percussion and palpation due to adverse effect that these procedures may have on the sound from the bowels
- Bowel sounds listen with the diaphragm of the stethoscope just for up to 30 seconds below the umbilicus (normal, 'tinkling', absent)
- High pitched or absent sounds may indicate bowel obstruction
- Absence of sounds may be also be caused by peritonitis



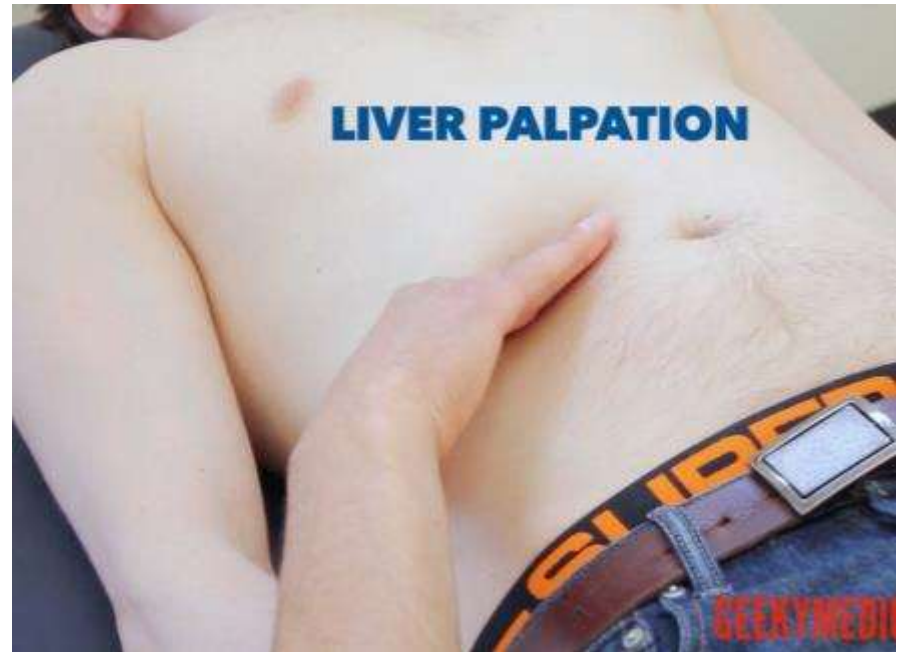
Physical examination of the patient: abdomen light palpation

- Gently palpate all nine areas
- Start away from known pain
- If there is pain on light palpation, try and determine if this is rebound tenderness



Physical examination of the patient: abdomen deep palpation

- Note any masses or structural abnormality
- Masses should be described in terms of site, size, shape, surface, consistency, mobility, movement with respiration, tenderness and pulsatility

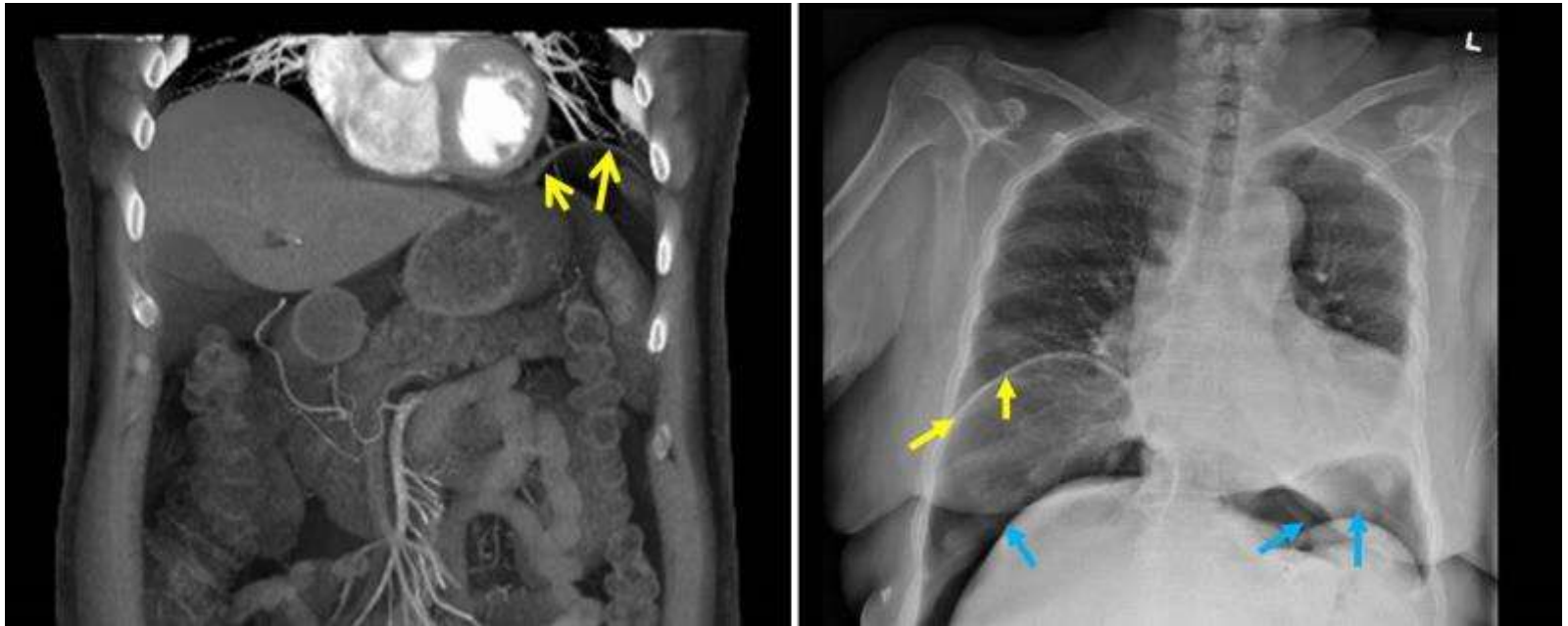


Physical examination of the patient: abdomen percussion

- You should percuss any lumps or masses identified on palpation to determine their size and nature
- Percuss individual organs to help determine their size
- If the abdomen appears distended and you suspect the presence of ascites test for 'shifting dullness' and 'fluid thrill'

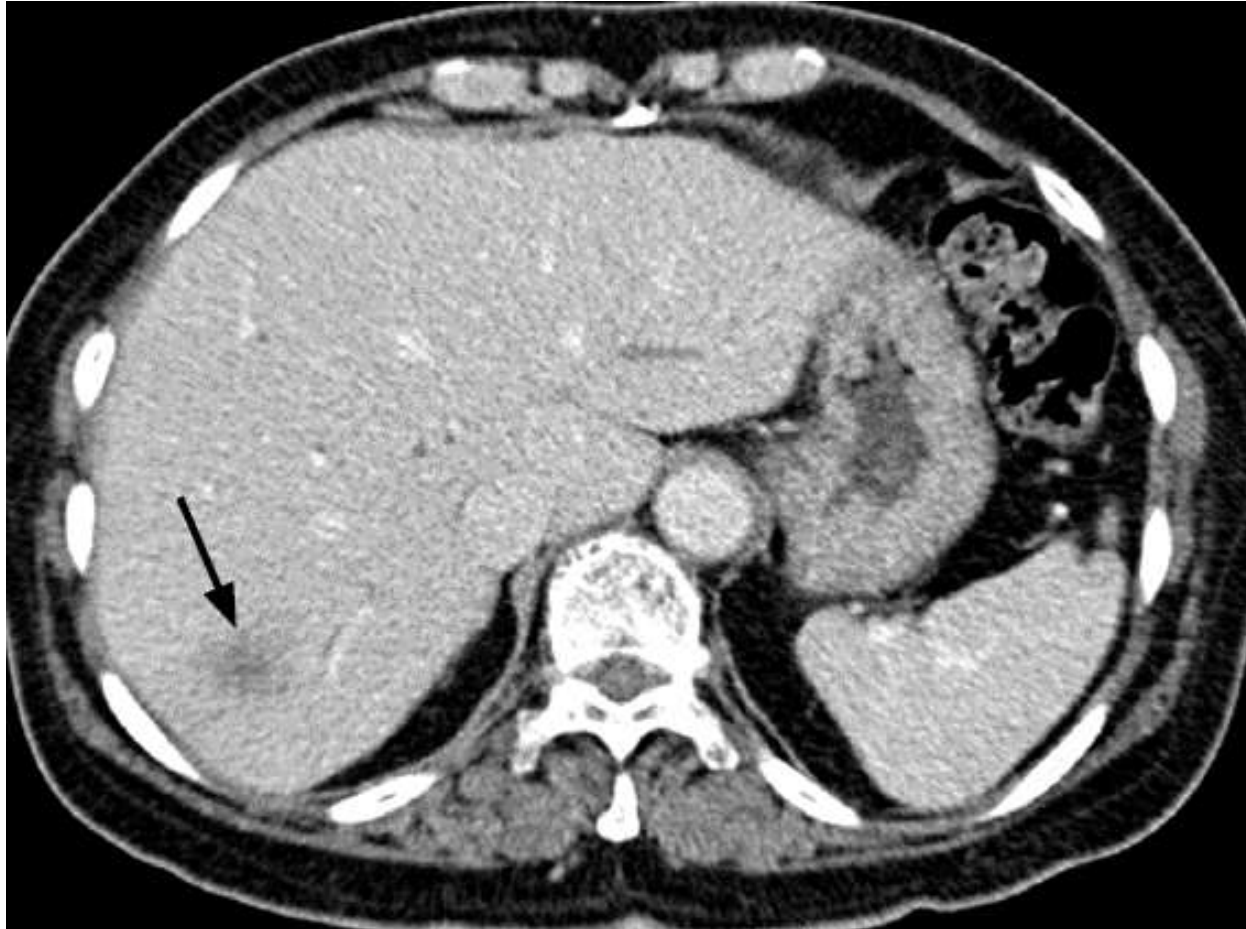


Instrumental methods: flat-plate film of the abdomen



These two radiographs show the importance of including the diaphragm on the plain-film abdomen x-ray

Instrumental methods: computed tomography



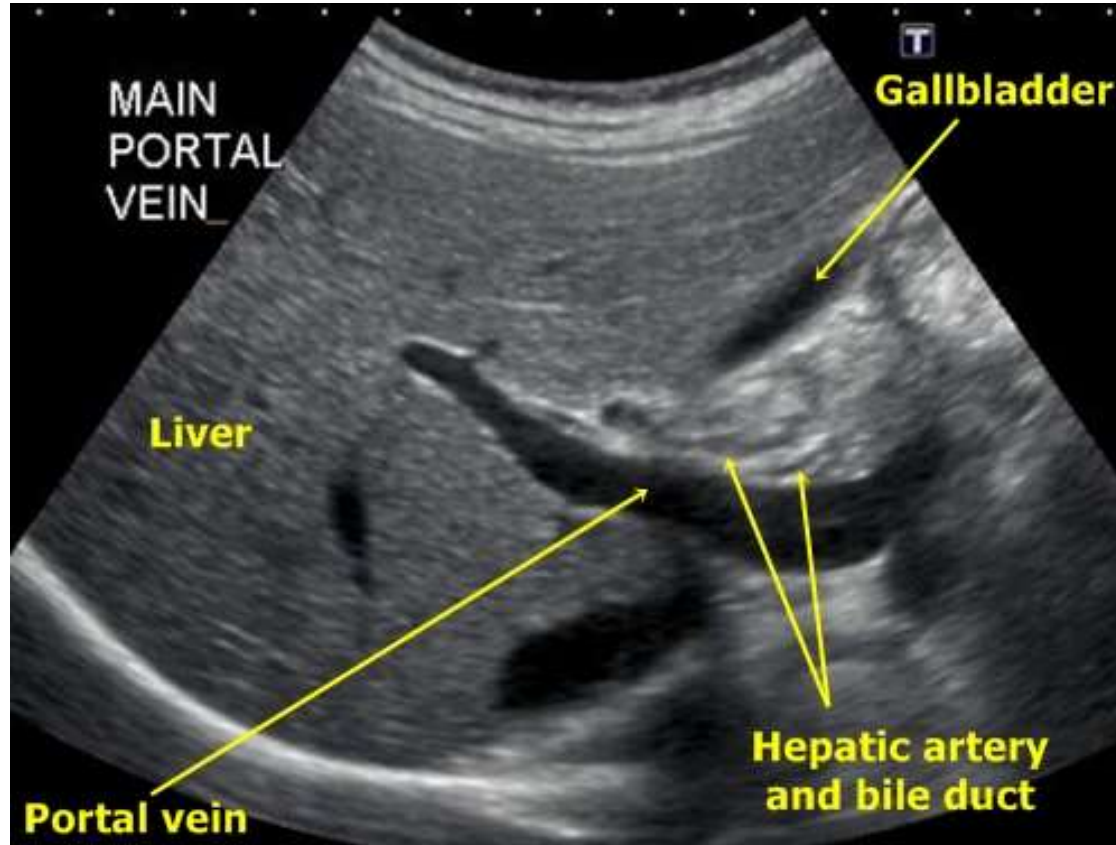
The hypo-attenuating lesion in segment 7 of the liver

Instrumental methods: magnetic resonance imaging



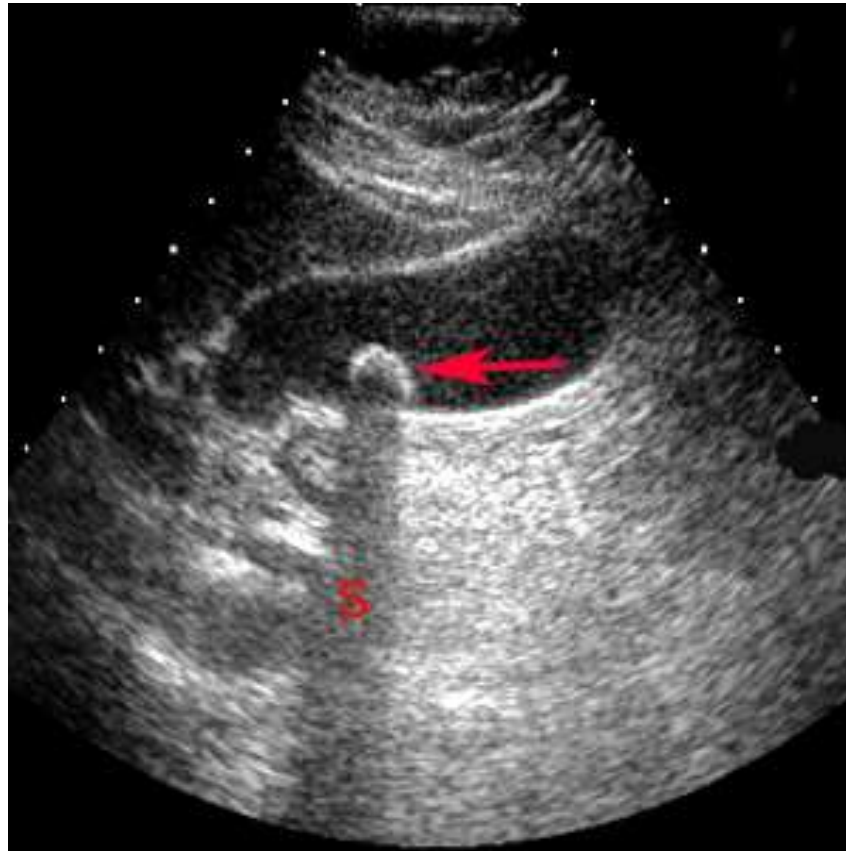
A hypervascular nodular lesion in the right liver lobe

Instrumental methods: abdominal ultrasonography



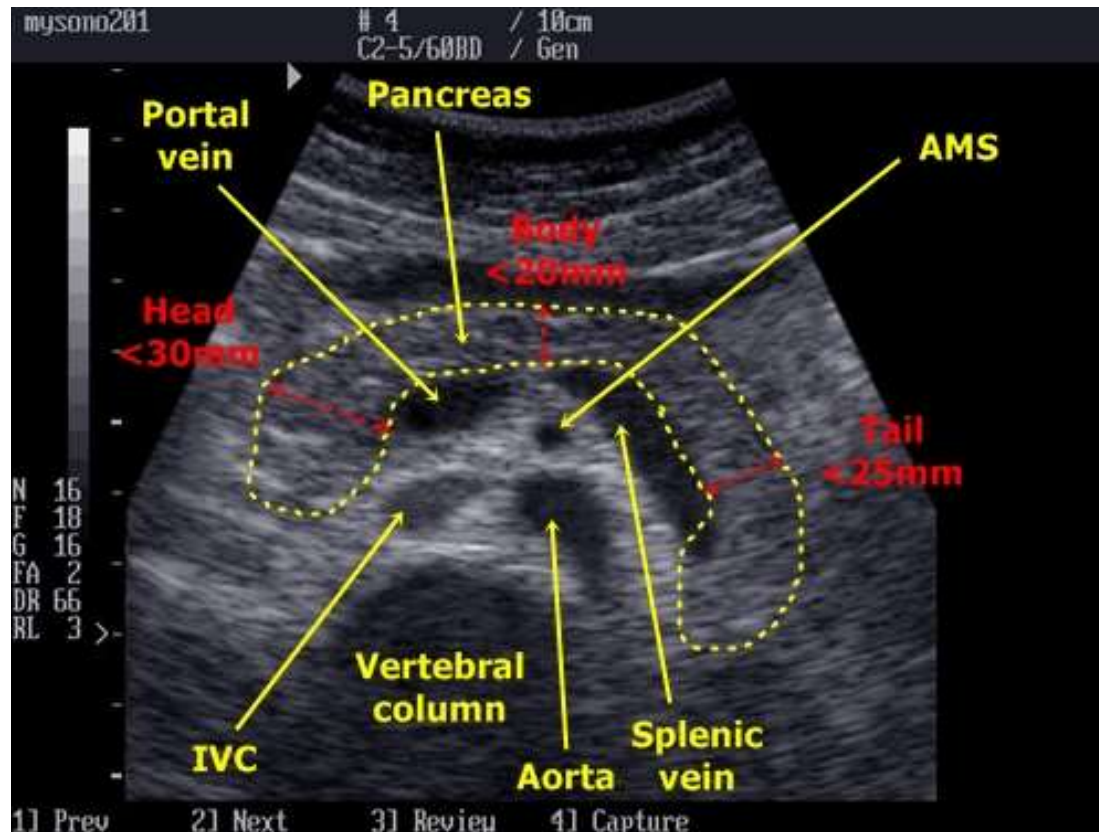
In liver hilum we see portal vein entering the liver; two slim lines above portal vein is hepatic artery and bile duct; in this static picture without the possibility to check the blood flow it is practically impossible to differentiate them

Instrumental methods: abdominal ultrasonography



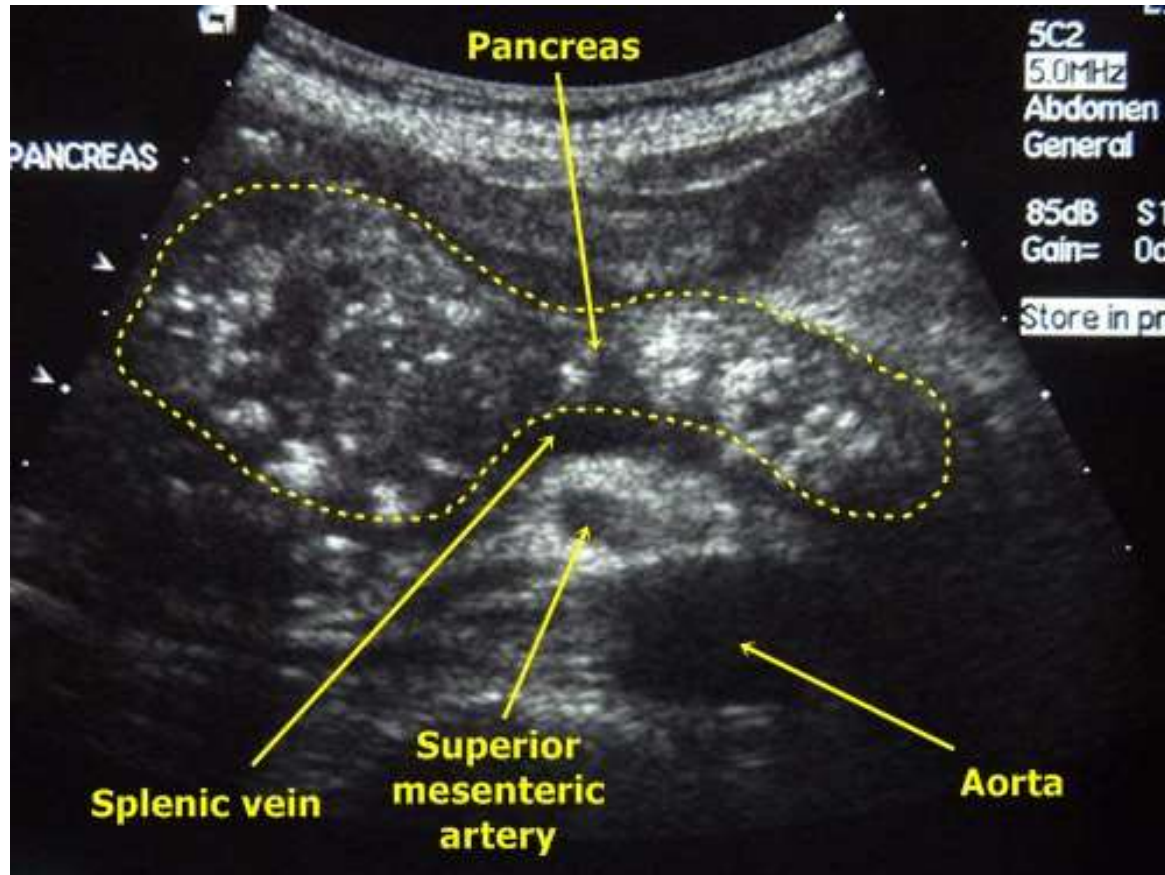
Gallstone (red arrow) within the gallbladder produces a bright surface echo and causes a dark acoustic shadow (S)

Instrumental methods: abdominal ultrasonography



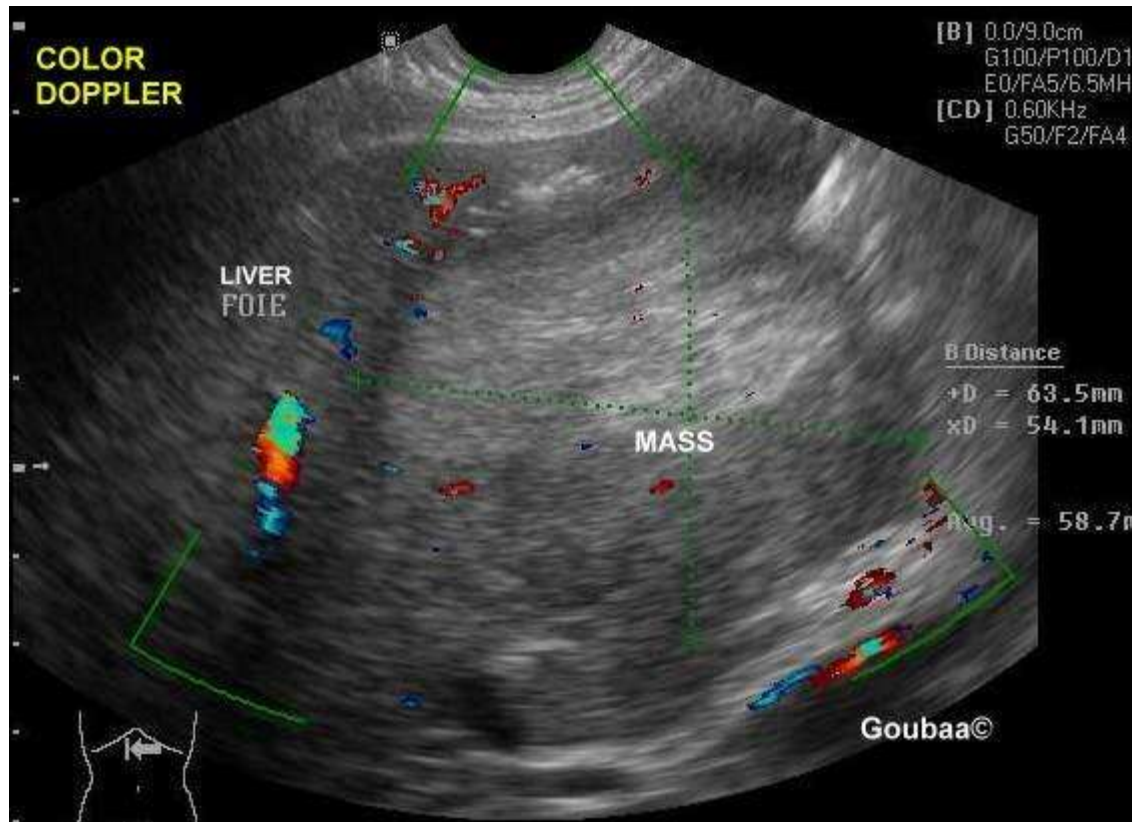
Pancreas and its proportions + neighbouring anatomical structures in classic transverse epigastric plain

Instrumental methods: abdominal ultrasonography



Granular structure of the pancreas with calcifications

Instrumental methods: color Doppler



Tumor gallbladder

Instrumental methods: endoscopic ultrasonography



Radial endoscopic ultrasound showing grossly dilated extrahepatic bile duct and dilated pancreatic duct

Instrumental methods: endoscopic retrograde cholangiopancreatography

- Endoscopic retrograde cholangiopancreatography (ERCP) is a procedure for examine the pancreatic and bile ducts
- In the duodenum a small opening is identified (ampulla) and a small plastic tube (cannula) is passed through the endoscope and into this opening
- Dye (contrast material) is injected and X-rays are taken to study the ducts of the pancreas and liver



laboratory methods: tests

- Blood count
- Blood sugar tests
- Blood Coagulation
- Electrolytes
- Bilirubin blood test
- Plasma proteins
- Blood ammonia
- Alkaline phosphatase
- Gamma glutamyl transferase
- Enzyme & protein blood tests
- Lipid blood tests
- C-reactive protein
- Fecal occult blood test
-



Photo courtesy of Cepheid

laboratory methods: blood coagulation

- A prolongation of the prothrombin time (PT) is an indicator of hepatic dysfunction as the synthesis of the coagulation factors is impaired in hepatocellular disease
- Impaired absorption in the gut, particularly of fat soluble substances, often accompanies liver disease which may result in decreased absorption of vitamin K, needed for the production of factors II, VII, IX and X
- Dysfibrinogenemias, an interferent with fibrin-polymerization, have also been reported in severe liver disease
- Fibrinolysis is increased in some patients with hepatic disease, presumably because of reduced synthesis of plasmin inhibitors by the diseased liver

laboratory methods: bilirubin blood test

- Bilirubin is a waste product of the normal breakdown of red blood cells
- Bilirubin passes through the liver and eventually out of the body — mostly in feces, a small amount in urine
- Before reaching the liver, bilirubin is called unconjugated (uncombined)
- In the liver, bilirubin combines with certain sugars to create a water-soluble form called conjugated bilirubin
- Conjugated bilirubin passes out of the liver, and in the colon, it is converted back into the unconjugated form en route to being excreted from the body
- Amount of total bilirubin conjugated bilirubin is called direct and unconjugated bilirubin is called indirect
- Normal levels are: direct bilirubin: 0 to 0.3 mg/dL, total bilirubin: 0.3 to 1.9 mg/dL (normally, 90% or more of serum bilirubin is indirect)
- Higher than normal levels of direct or indirect bilirubin may indicate different types of liver problems
-

laboratory methods: bilirubin fractions in blood and urine



Fraction	In Serum As	Measured As	Present in Urine
Unconjugated	Albumin-bound	Indirect-reacting bilirubin	Never
Conjugated	Unbound	Direct-reacting bilirubin	Yes, when serum bilirubin level is elevated

laboratory methods: plasma proteins

- Plasma total protein concentrations in liver disease often are near normal because a decrease of albumin is offset by an increase of globulins and the concept of the ratio of albumin : globulin (A/G ratio), as used in the past, reflects this (Reference Range: 1.5:1 to 3.0:1)
- Most useful are albumin measurements in the assessment of the severity of impairment of the synthetic functions of the liver: chronic proliferative disease of the liver (cirrhosis, chronic hepatitis) leads to polyclonal hypergammaglobulinemia as demonstrated by the “beta-gamma bridging” on serum protein electrophoresis
- IgA is affected more than other immunoglobulins because most is manufactured in lymphoid tissue of the gut
- Albumin is also important in the evaluation of renal disease
- Reference Range: total proteins, 6.0 - 8.0 g/dL, albumin, 3.3 - 5.0 g/dL

laboratory methods: blood ammonia

- Elevated blood ammonia is seen in severe liver disease and in actual or impending hepatic coma
- The elevations are due to reduced removal of ammonia from the portal blood, and "shunting" of portal blood, bypassing the liver
- Proteins absorbed in the gut first pass through the liver in the portal circulation
- Blood ammonia levels show some, but not close, correlation with the presence and deepness of the coma
- Reference Range: 10 - 35 $\mu\text{mol/L}$

laboratory methods: alkaline phosphatase

- Alkaline Phosphatase (ALP) is present in high concentration in the lining of the biliary system (bile canaliculi) and escapes into the bloodstream when the lining cells are affected by inflammation, necrosis, or obstruction
- Elevations of ALP in the blood are a sensitive indicator of a biliary process but they are also seen in liver cell damage: the higher the alkaline phosphatase, the greater the chances for post-hepatic obstruction
- It must be kept in mind that there are other important sources of ALP such as the bones and the gastrointestinal mucosa, the placenta, and certain tumors
- Reference Range: 30 - 130 U/L

laboratory methods: gamma glutamyl transferase

- Gamma glutamyl transferase (GGT) is found in liver and pancreas, but in even larger amounts in the kidney
- Elevations of the hepatic GGT can be due to a bone disease or due to cholestasis
- GGT determinations are helpful in differentiating bone and liver sources of alkaline phosphatase, since there are no significant amounts of GGT in bone
- GGT is also a sensitive indicator of alcohol-induced liver disease and of recent alcohol ingestion
- Reference Range: male, <38 U/L; female, <24 U/L

laboratory methods: enzyme & protein blood tests

- Alanine Aminotransferase (ALT; also called SGPT), goal value: 5 – 50 U/L
- Aspartate Aminotransferase (AST; SGOT), goal value: 7 – 40 U/L
- Creatinine (Cr), goal value: 0.7 – 1.4 mg/dL
- Creatine Kinase (CK), goal value: 30 – 220 U/L
- Lactate dehydrogenase (LDH), goal value: 100 - 220 U/L
- Myoglobin (Mb), goal value: 30 – 90 µg/mL
- Troponin T (cTNT), goal value: 0.0 - 0.10 µg/mL

laboratory methods: lipid blood tests

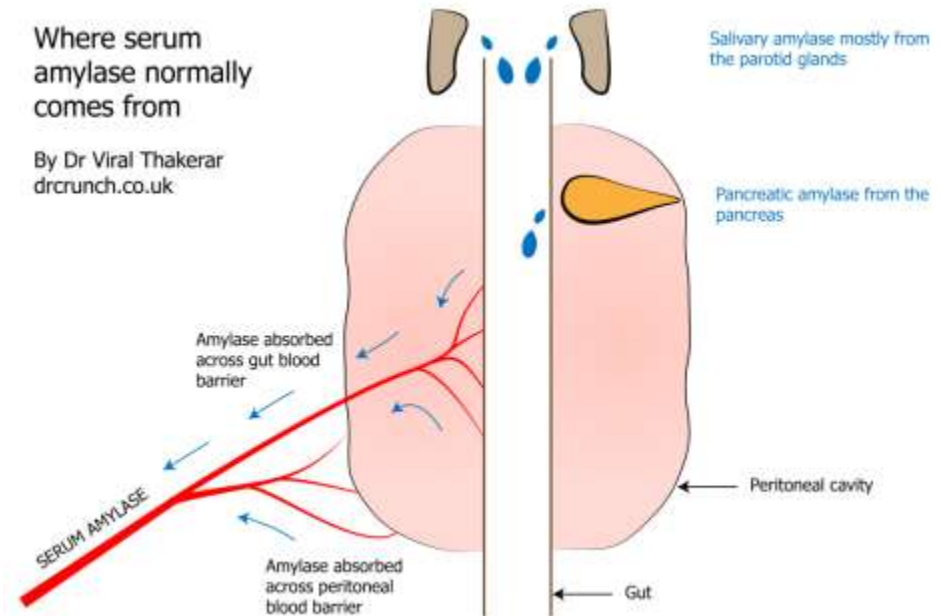
- Total cholesterol. A high level can put you at increased risk of heart disease. Ideally, total cholesterol should be below 200 milligrams per deciliter (mg/dL), or 5.2 millimoles per liter (mmol/L)
- Low-density lipoprotein (LDL) cholesterol. Too much of it in blood causes the accumulation of fatty deposits (plaques) in arteries (atherosclerosis). Ideally, your LDL cholesterol level should be less than 130 mg/dL (3.4 mmol/L), and under 100 mg/dL (2.6 mmol/L) is even better
- High-density lipoprotein (HDL) cholesterol. Ideally, your HDL cholesterol level should be 60 mg/dL (1.6 mmol/L) or higher, though it's common that HDL cholesterol is higher in women than men.
- Triglycerides. High levels increase risk of heart disease. Ideally, triglyceride level should be less than 150 mg/dL (1.7 mmol/L)

laboratory methods: C-reactive protein

- CRP is a sign of inflammation somewhere in the body
- Inflammation plays a central role in the process of atherosclerosis, in which fatty deposits clog arteries
- CRP test result can be interpreted as putting heart disease risk at:
 - Low risk (less than 1.0 milligrams per liter, or mg/L)
 - Average risk (1.0 to 3.0 mg/L)
 - High risk (above 3.0 mg/L)

laboratory methods: serum amylase and lipase

- Amylase and lipase are enzymes produced by the pancreas that help to digest food
- If the pancreas is damaged, high levels of these enzymes can be detected in the bloodstream
- Checking amylase and lipase levels can help determine if you have pancreatitis



laboratory methods: secretin stimulation test



- The secretin stimulation test measures the ability of the pancreas to respond to a hormone called secretin
- The small intestine produces secretin when partially digested food enters the area from the stomach
- Normal value ranges may vary slightly depending on the lab doing the test
- Abnormal values may mean that the pancreas is not working properly

laboratory methods:

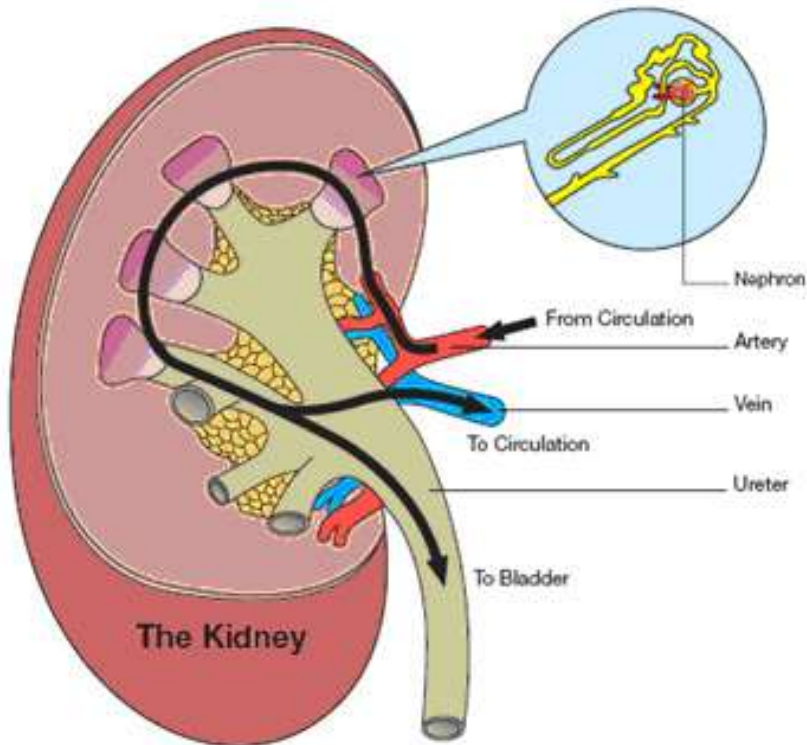
Fecal occult blood test

- Fecal occult blood (FOB) refers to blood in the feces that is not visibly apparent (unlike other types of blood in stool such as melena or hematochezia)
- A fecal occult blood test (FOBT) checks for hidden (occult) blood in the stool (feces)
- Newer tests look for globin, DNA, or other blood factors including transferrin, while conventional stool guaiac tests look for heme

Lecture 7

Approach to the patient with
affection and disease of the kidneys

Plan of the lecture



Approach to the Patient with Affection and Disease of the Kidneys

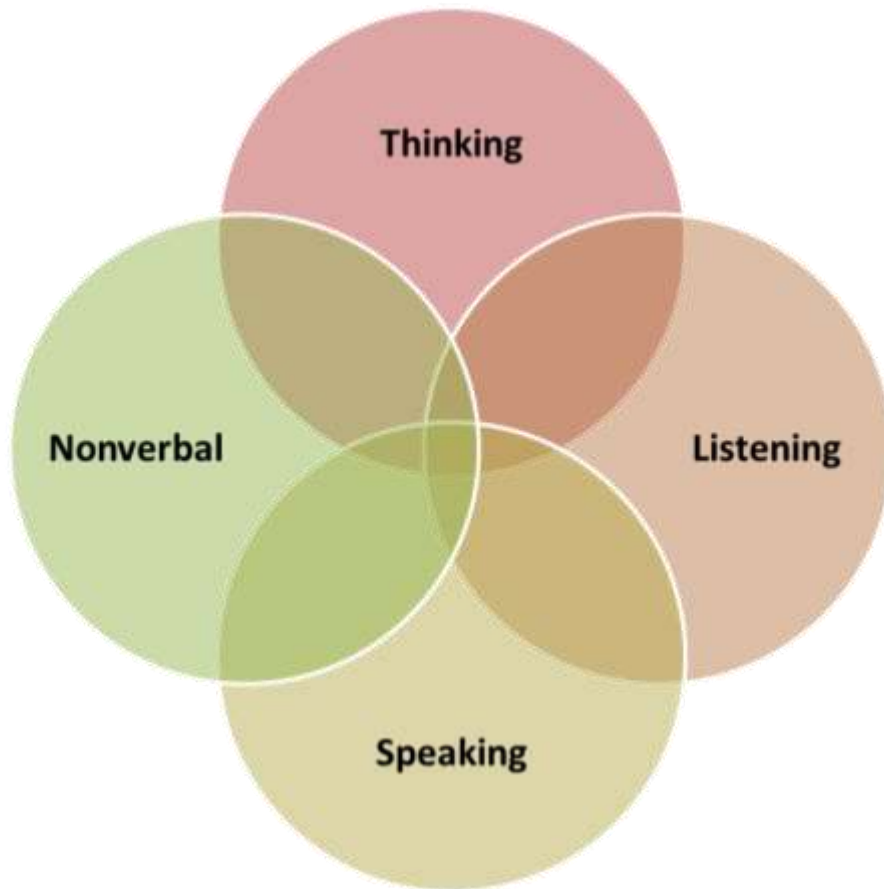
- Interviewing of the patient
- Physical examination of the patient
- Instrumental methods
- laboratory methods

Interviewing of the patient: four overlapping processes

1. *engaging* (connecting with patients and establishing a good working relationship)
2. *focusing* (agreeing on the target of motivational enhancement and directing the conversation toward it)
3. *evoking* (drawing out the patients' own motivations for changing the target behavior)
4. *planning* (developing commitment to change and formulating a specific plan of action)



Interviewing of the patient: Good questions to get started on the core interview



Communication skills:

- Active listening
- Empathy
- Building rapport
- Open-ended questions
- Leading questions
- Silence
- “Why” questions
- Nonverbal communication cues

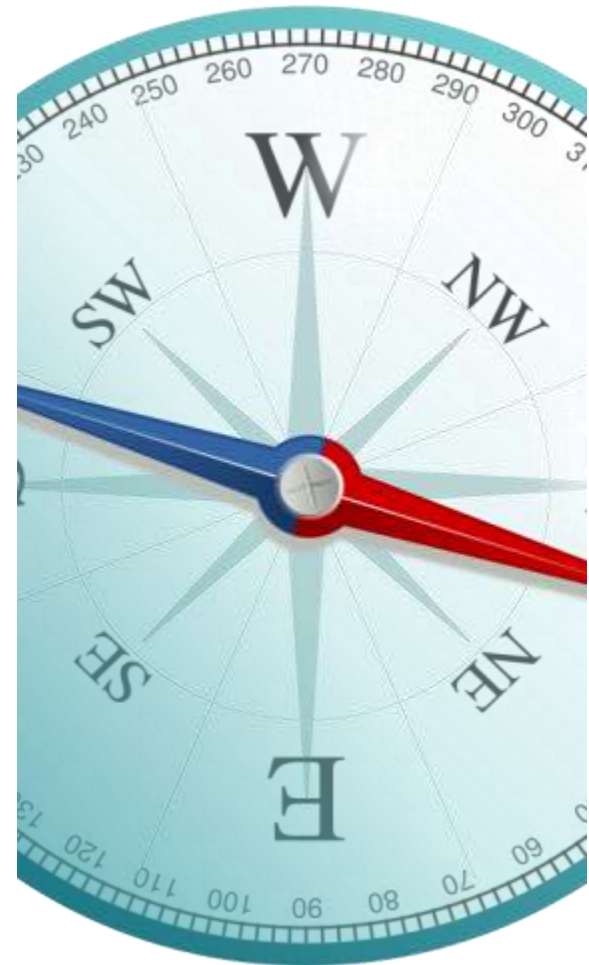
Interviewing of the patient: Good questions to get started on the core interview

- What is your chief complaint?
- Tell me why you're here today
- Tell me about your injury
- What can I do to help you?
- Explain to me your understanding of your injury



Interviewing of the patient: Patient profile

- Age
- Sex
- Race/Ethnicity
- Handedness
- Ht-Wt-BMI-Body type
- Primary language
- Barriers to learning
- Learning preference
- Unique rehabilitation goals



Interviewing of the patient: complaints

- Kidney' lumbar and abdominal pain
- Disordered urination
- Swelling of the legs and puffiness around the eyes
- Fatigue and weakness
- High blood pressure
- Headache
- Dizziness
- Deranged vision
- Dyspnea
- Loss of appetite, nausea and vomiting
- Changes in the urine -- its color, odor, and consistency
- Hyperthermia
- Thirst
- Itching, easy bruising, and pale skin
- Bleeding
- Numbness in the feet or hands
- Disturbed sleep
- Restless legs syndrome
- Shortness of breath from fluid accumulation in the lungs
- Chest pain due to pericarditis
- Bone pain and fractures
- Muscle twitching or cramping
- Decreased sexual interest and erectile dysfunction

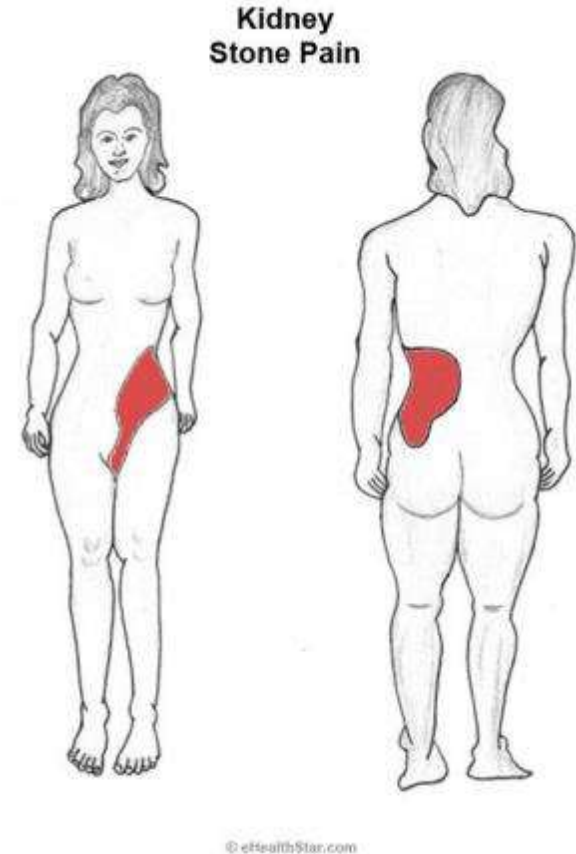
Interviewing of the patient: complaints (kidney' lumbar pain)

- Kidneys' lumbar pain caused by the kidneys is typically felt in the flank area, which is in the back, just at the lower edge of the ribs on either side of the spine
- This pain caused by the kidneys tends to be sharp and severe, to and occur in waves
- Depending on the cause, it may radiate down the flank to the groin or toward the abdominal area
- Some individuals may develop fever, painful urination (dysuria), blood_in_the urine, nausea, and vomiting
- The renal tissue is devoid of pain receptors and the pain is felt when the capsule or the pelvis is distended



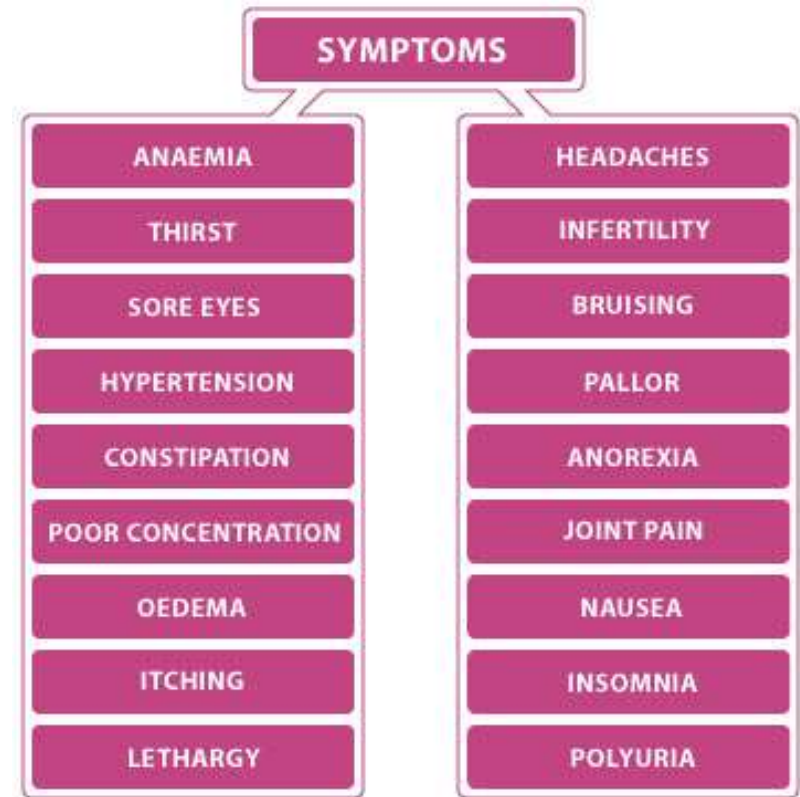
Interviewing of the patient: complaints (kidney' abdominal pain)

- Kidney' abdominal pain names renal colic and commonly caused by kidney stones
- Renal colic typically begins in the abdomen and often radiates to the hypochondrium or the groin
- It is typically colicky (comes in waves) due to ureteric peristalsis, but may be constant and is often described as one of the strongest pain sensations known
- The pain occurs when a stone becomes lodged in the ureter, the slender tube that connects the kidney with the bladder



Interviewing of the patient: complaints (kidney' pain causes)

- Bleeding in kidney (hemorrhage)
- Blood clots in kidney veins (renal vein thrombosis)
- Urinary tract infection
- Arteriosclerosis /atherosclerosis
- Horseshoe kidney
- Kidney tumor
- Kidney infection (pyelonephritis)
- Kidney swelling due to a backup of urine (hydronephrosis)
- Polycystic kidney disease



Interviewing of the patient: complaints (disordered urination)

- Dysuria
- Diuresis
- Urinary frequency
- Nocturia
- Isuria
- Urinary hesitancy and slow urination
- Incontinence



Interviewing of the patient: complaints (dysuria)

- Dysuria is painful or uncomfortable urination, typically a sharp, burning sensation
- Some disorders cause a painful ache over the bladder or perineum
- Dysuria is an extremely common symptom in women, but it can occur in men and can occur at any age
- The most common causes of dysuria are cystitis and urethritis due to a sexually transmitted disease (STD)



Interviewing of the patient: complaints (diuresis)

- Diuresis is defined as secretion of urine during a certain period of time
- Increased diuresis occurs in diabetes mellitus and diabetes insipidus, acute renal failure, during mild to moderate hypothermia (cold-induced diuresis)
- Coffee, tea, certain foods, diuretic drugs, anxiety, fear, some steroids cause increase diuresis
- Types of diuresis:
 - Positive (the amount of urine excreted exceeds the volume of liquid taken)
 - Negative (the reverse ratio)



Interviewing of the patient: complaints (urinary frequency)

- Urinary frequency is the need to urinate many times during the day, at night (nocturia), or both but in normal or less-than-normal volumes
- Frequency may be accompanied by a sensation of an urgent need to void (urinary urgency)
- Urinary frequency is distinguished from polyuria, which is urine output of >3 L/day
- The most common causes of urinary frequency are urinary tract Infection (UTIs), urinary incontinence, benign prostatic hyperplasia (BPH), urinary tract calculi



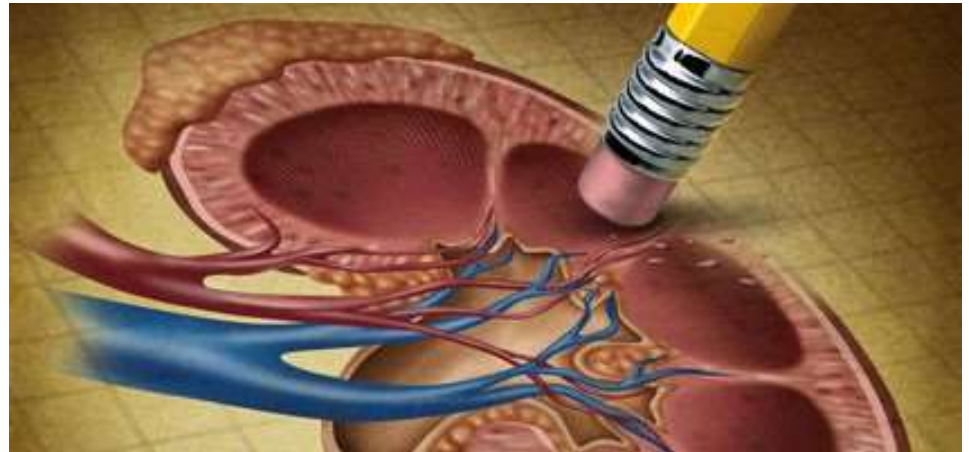
Interviewing of the patient: complaints (nocturia)

- A healthy person urinates during night not more than once
- Nocturia is a condition in which the individual has to wake at night one or more times for voiding
- Nocturia has four major underlying causes: global polyuria, nocturnal polyuria, bladder storage disorders, or mixed etiology
- Causes:
 - Cardiac (after oliguria during day time occurs in cardiac decompensation and is explained by a better renal function at night, i.e at rest)
 - Renal (may concur with polyuria in renal dysfunction, at the final stage of chronic glomerulonephritis, chronic pyelitis, vascular nephrosclerosis and other chronic renal diseases)



Interviewing of the patient: complaints (Isuria)

- Isuria is an excretion of urine at a uniform rate (about equal intervals with evacuation of about equal portions of urine)
- The most common cause of isuria is chronic renal insufficiency



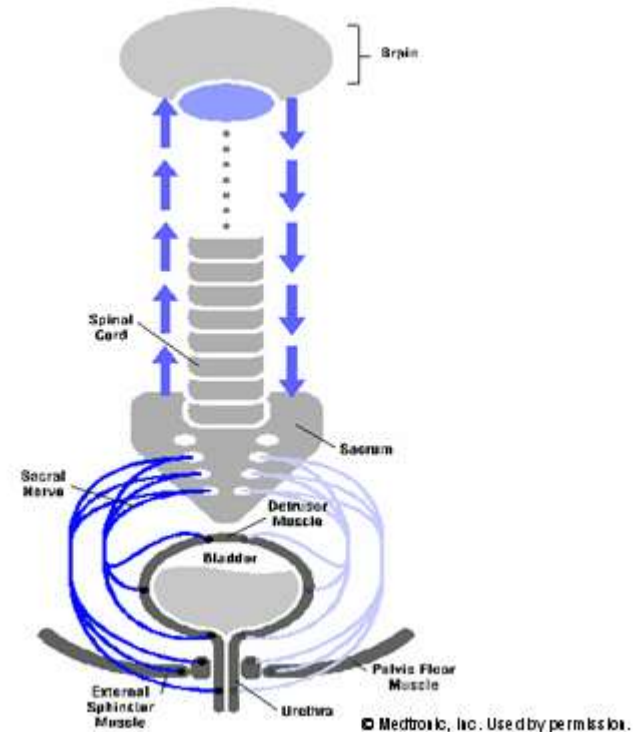
Interviewing of the patient: complaints (urinary hesitancy and slow urination)

- Urinary hesitation is a difficulty in beginning the flow of urine
- Slow urination is a slow urinary flow
- The most common causes of urinary hesitation and slow urination are urethral obstruction due to benign prostatic hyperplasia, prostatitis, urinary tract infection, cystitis, medications (nasal decongestants, tricyclic antidepressants, and anticholinergics which may be used for incontinence) etc.



Interviewing of the patient: complaints (incontinence)

- Incontinence is an inability to control urination voluntarily
- Incontinence may involve periodic involuntary urination, or a continual, slow trickle of urine from the urethra
- Incontinence may result from urinary bladder or urethral problems, damage or weakening of the muscles of the pelvic floor, or interference with normal sensory or motor innervation in the region
- Renal function and daily urinary volume are normal



Interviewing of the patient: complaints (swelling of the legs and puffiness around the eyes)

- Swelling of the legs and puffiness around the eyes (oedema) in patients with kidney disease is for two reasons:
 - A heavy loss of protein in the urine
 - Impaired kidney (renal) function



Interviewing of the patient: complaints (fatigue and weakness)

- Kidneys disease , which cause fatigue and weakness when the concentration of certain chemicals in the blood builds up to toxic levels or from anemia



Interviewing of the patient: complaints (high blood pressure)

- High blood pressure caused by the kidneys' hormonal response to narrowing of the arteries supplying the kidneys (renal artery stenosis) called renal (secondary) hypertension
- Due to low local blood flow, the kidneys mistakenly increases blood pressure of the entire circulatory system
- Patients with renal hypertension have a diastolic blood pressure of more than 100 mmHg and are at increased risk of end organ dysfunction, including permanent kidney damage, if inadequate pharmacologic therapies are used to control blood pressure



Interviewing of the patient: complaints (headache)

- Headache is a rare symptom for kidney disease patients
- Other causes:
- Main causes the headache in kidney disease:
 - waste product accumulation
 - renal anemia
 - high blood pressure
 - Headache is a common side effects of some drugs used for treatment of kidney disease, such as steroids therapy etc.



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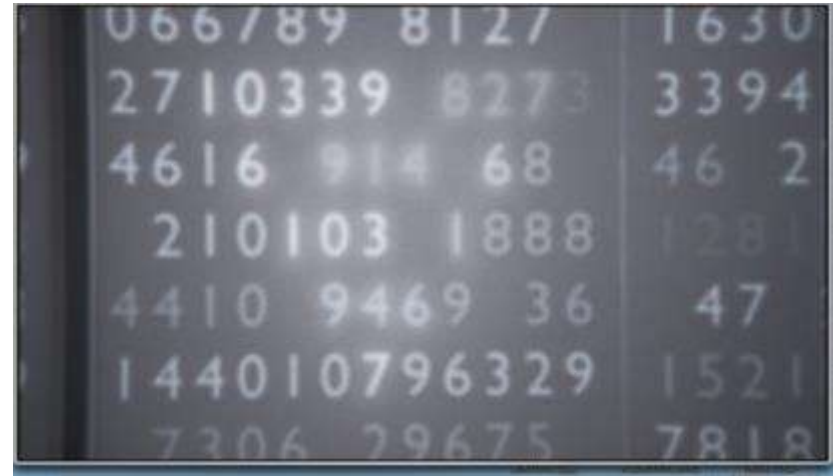
Interviewing of the patient: complaints (dizziness)

- Anaemia associated with kidney disease depletes patient's brain of oxygen which may cause dizziness
- Other causes:
 - Sleep disorder
 - Uremic toxins
 - Dialysis side effect



Interviewing of the patient: complaints (deranged vision)

- Vision may be affected because of papilloedema (swelling of the optic disc)



Interviewing of the patient: complaints (dyspnea)

- Shortness of breath is one of the symptoms in kidneys diseases
- Main causes:
 - metabolic acidosis
 - Serious fluid retention



Interviewing of the patient: complaints (loss of appetite, nausea and vomiting)

- Loss of appetite due to nausea and vomiting is classical signs of uremia in kidneys diseases



Interviewing of the patient: complaints (hyperthermia)

- Hyperthermia is elevated body temperature due to failed thermoregulation that occurs when a body produces or absorbs more heat than it dissipates
- Extreme temperature elevation then becomes a medical emergency requiring immediate treatment to prevent disability or death
- Hyperthermia is a core (oesophageal, tympanic) temperature above 40.5°C
- Hyperthermia may be an extreme form of pyrogen-induced fever associated with infection, inflammation, neoplasia, and acute renal failure



Interviewing of the patient: complaints (thirst)

- Thirst is the craving for fluids, resulting in the basic instinct to drink
- Thirst is an essential mechanism involved in fluid balance
- Thirst arises from a lack of fluids or an increase in the concentration of certain osmolites, such as salt
- If the water volume of the body falls below a certain threshold or the osmolite concentration becomes too high, the brain signals thirst
- Continuous dehydration can cause many problems, but is most often associated with renal problems and neurological problems such as seizures
- Excessive thirst, known as polydipsia, along with excessive urination, known as polyuria, may be an indication of diabetes mellitus or diabetes insipidus

Interviewing of the patient: complaints (thirst)



Interviewing of the patient: complaints (itching, easy bruising, and pale skin)

- Itch is a sensation that causes the desire or reflex to scratch, and has many similarities to pain, and while both are unpleasant sensory experiences, their behavioral response patterns are different; pain creates a withdrawal reflex, while itch leads to a scratch reflex
- Bruising easily means that the small blood vessels beneath the skin break easily and frequently, they then leak blood into the surrounding tissue and create discolorations
- Human skin color ranges in variety from the darkest brown to the pale and lightest pinkish-white hues
- These skin changes often caused in chronic kidneys diseases patients

Interviewing of the patient: complaints (itching, easy bruising, and pale skin)



Interviewing of the patient: complaints (bleeding)

- Bleeding, technically known as hemorrhaging or haemorrhaging , is blood escaping from the circulatory system
- Bleeding can occur internally, where blood leaks from blood vessels inside the body, or externally, either through a natural opening such as the mouth, nose, ear, urethra, vagina or anus, or through a break in the skin
- A healthy person can endure a loss of 10–15% of the total blood volume without serious medical difficulties
- Platelet dysfunction is the main factor responsible for hemorrhagic tendencies in advanced kidney disease, and occurs both as a result of intrinsic platelet abnormalities and impaired platelet-vessel wall interaction
- Patients with end-stage renal disease develop bleeding disorders mainly in the form of diatheses at cutaneous, mucosal, or serosal sites, etc.

Interviewing of the patient: complaints (bleeding)



Interviewing of the patient: complaints (numbness and tingling in the feet or hands)

- Numbness and tingling are unusual prickling sensations that can happen in any part of human body, but they are generally noticed in hands, feet, arms, and legs
- Causes of tingling in the hands and feet include diabetes, kidney disorders, liver disease, vascular damage and blood diseases, amyloidosis, connective tissue disorders and chronic inflammation, hormonal imbalances (including hypothyroidism), and cancers and benign tumors that impinge on nerves



Interviewing of the patient: complaints (disturbed sleep)

- Common conditions often associated with sleep problems include heartburn, diabetes, cardiovascular disease, musculoskeletal disorders, kidney disease, mental health problems, neurological disorders, respiratory problems, and thyroid disease
- Kidney disease can cause waste products to build up in the blood and can result in insomnia or symptoms of restless legs syndrome
- Nocturia is the need to get up frequently to urinate during the night, and is a common cause of sleep loss, especially among older adults



Interviewing of the patient: complaints (restless legs syndrome)

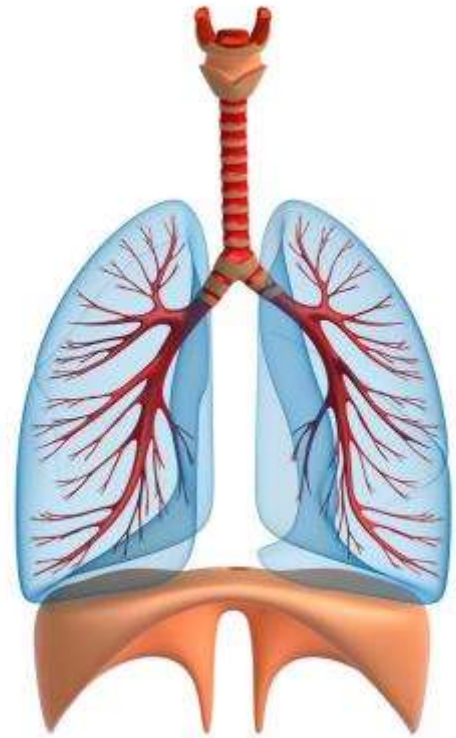
- Restless legs syndrome (RLS) is a disorder characterized by throbbing, pulling, creeping, or other unpleasant sensations in the legs and an uncontrollable, and sometimes overwhelming, urge to move them
- Symptoms occur primarily at night when a person is relaxing or at rest and can increase in severity during the night
- Moving the legs relieves the discomfort
- RLS often is related to the chronic kidney failure, diabetes, and peripheral neuropathy



Interviewing of the patient: complaints

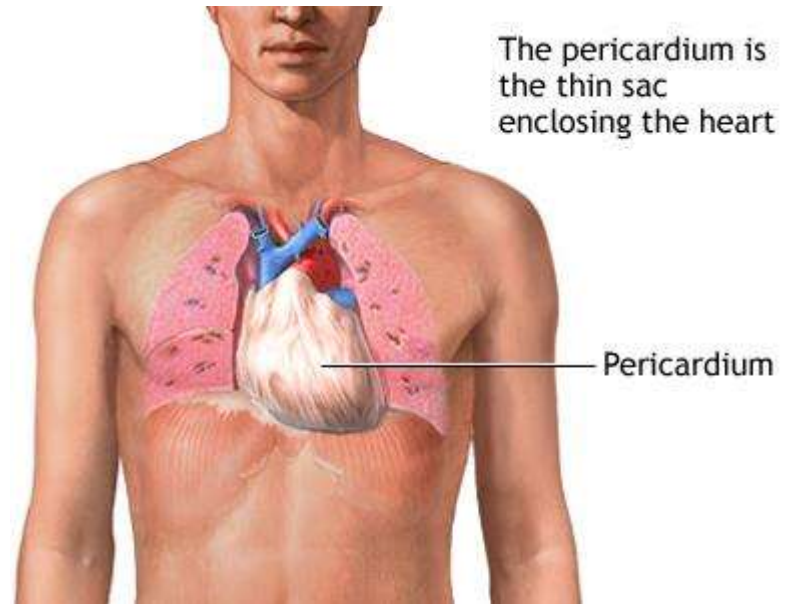
(shortness of breath from fluid accumulation in the lungs)

- Pulmonary edema that is fluid accumulation in the air spaces and parenchyma of the lungs leads to impaired gas exchange and may cause respiratory failure with shortness of breath
- In kidney disease it is due to an injury to the lung parenchyma ("noncardiogenic pulmonary edema")



Interviewing of the patient: complaints (chest pain due to pericarditis)

- Pericarditis is a condition in which the membrane, or sac, around the heart is inflamed
- In many cases, the cause of pericarditis (both acute and chronic) is unknown
- Most cases of pericarditis are the result of autoimmune disorders , kidney failure, HIV/AIDS, cancer, tuberculosis, injuries from accidents or radiation therapy, and certain medicines, like phenytoin, warfarin and heparin, atc.



Interviewing of the patient: complaints (bone pain and fractures)

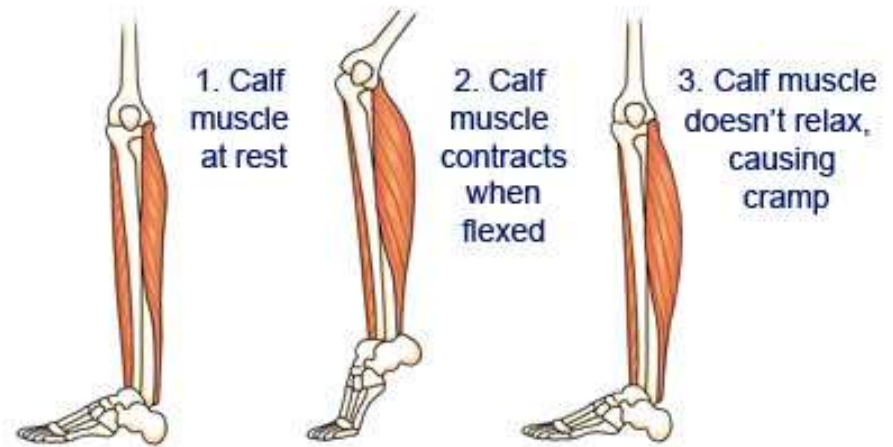
- Bone pain is coming from the bone and occurs as a result of a wide range of diseases and/or physical conditions such as chronic kidneys diseases
- Bone pain belongs to the class of deep somatic pain, often experienced as a dull pain that cannot be localized accurately by the patient
- Bone fracture is a medical condition in which there is a break in the continuity of the bone
- Bone fracture can be the result of high force impact or stress, or a minimal trauma injury as a result of certain medical conditions that weaken the bones, such as osteoporosis, chronic kidney disease, atc., where the fracture is then properly termed a pathologic fracture

Interviewing of the patient: complaints (bone pain and fractures)



Interviewing of the patient: complaints (muscle twitching or cramping)

- Muscle twitching or cramping, is a small, local, involuntary muscle contraction and relaxation which may be visible under the skin
- Muscle twitching or cramping have a variety of causes, the majority of which are benign, but can also be due to disturbances of the motor neurons , including chronic kidneys disease



Interviewing of the patient: complaints (decreased sexual interest and erectile dysfunction)

- Sexual dysfunction is a common finding in both men and women with chronic kidney failure
- Common disturbances include erectile dysfunction in men, menstrual abnormalities in women, and decreased libido and fertility in both sexes
- These abnormalities are primarily organic in nature and are related to uremia as well as the other comorbid conditions that frequently occur in the chronic kidney failure patient
- Fatigue and psychosocial factors related to the presence of a chronic disease are also contributory factors
- Disturbances in the hypothalamic-pituitary-gonadal axis can be detected before the need for dialysis but continue to worsen once dialytic therapy is initiated
- Impaired gonadal function is prominent in uremic men, whereas the disturbances in the hypothalamic-pituitary axis are more subtle
- By contrast, central disturbances are more prominent in uremic women

Interviewing of the patient: specific questions for set of complaints

Each of complaints will prompt a series of specific questions that will help arrive at a preliminary single diagnosis, or a group of different diagnoses



Interviewing of the patient: example of specific questions in complaint

- Character
- Location
- Severity
- Timing
- Duration
- Radiation
- Provocation
- Relieving conditions
- When did it first start?
- How often does it occur?
- Is it becoming more frequent with time?
- Were there associated symptoms
- Are the symptoms lasting longer?
- How the symptoms relate to food intake?

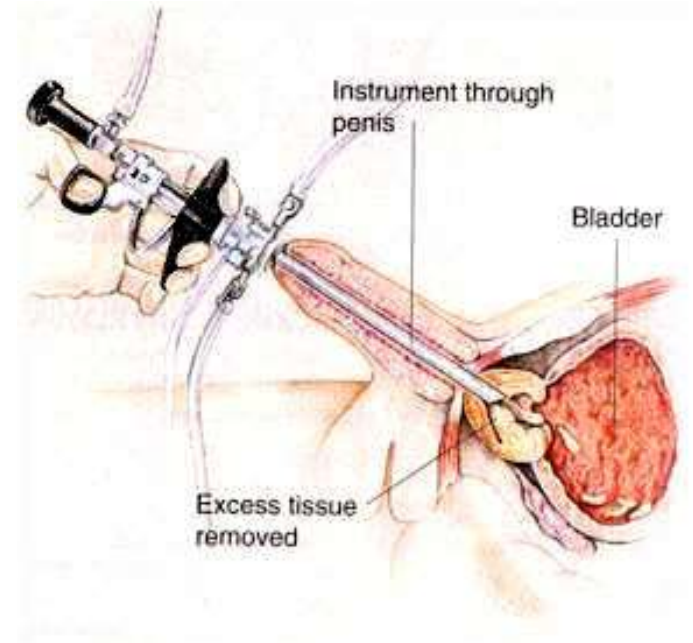
Interviewing of the patient: past medical history

In a medical encounter, a past medical history (abbreviated PMH), is the total sum of a patient's health status prior to the presenting problem

The image shows a close-up of a medical form. The section 'Past Medical History' is highlighted. It includes a 'Cardiac' subsection with options: ☐ None, ☐ Unknown, ☐ Angina, ☐ Arrhythmia, ☐ Cardiomyopathy, ☐ CHF, ☐ Congenital, ☐ Implanted Defib, and ☐ Other. To the right, there are more options: ☐ None, ☐ Unknown, ☐ Abdominal, ☐ Heart, and ☐ Lung. Below the 'Past Medical History' section, the 'Chronic Illnesses' section is partially visible, with options for 'sis/Renal' and 'intestinal'. A black pen is resting on the form.

Interviewing of the patient: prior or current treatment

- Any constantly used medications
- Previous surgery (e.g., for prostatic hypertrophy)
- Injections
- Chiropractic
- Exercise/PT (Physical Therapy)
- ER (Emergency Room)
- Massage therapy



Interviewing of the patient: any constantly used medications

- Drugs prescribed for diabetes mellitus, hypertension, cardiac disorders, hormonal disorders, cancer, arthritis, and psychiatric disorders are potential causes of renal dysfunction
- The long-term use of NSAIDs, phenacetin, barbiturates, camphor, antibiotics (gentamicin, tetracyclines, penicillin G, cyclophosphamide and others) and some other medicines may seriously reduce renal function
- Dysuria can occur with the use of pumpkin seeds, the use of a number of topical hygiene products, including vaginal sprays, vaginal douches, and bubble baths

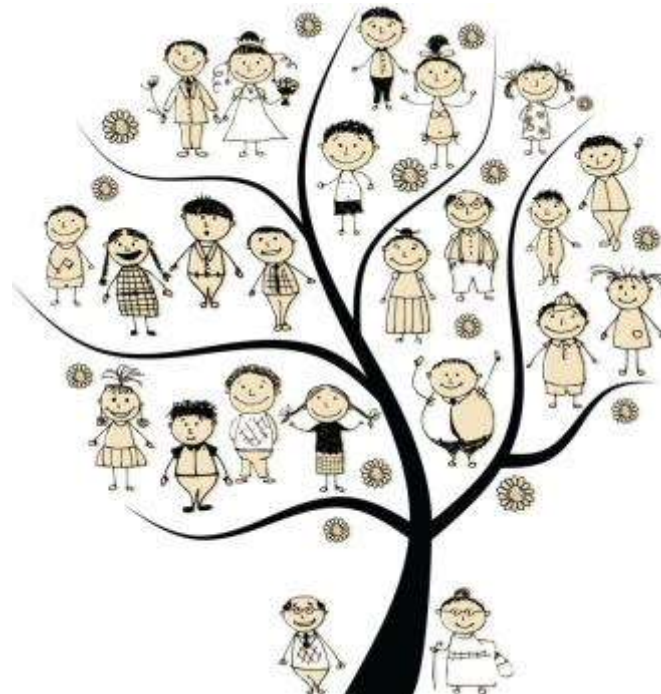
Interviewing of the patient: previous treatment and present status

- Previous Treatment
 - What?
 - Where?
 - When?
 - By whom?
- Present Status
 - Better vs. same vs. worse



Interviewing of the patient: family history and genetic risk

- Certain kidney illnesses may occur in more than one member of a family (stones, renal tumors (some types), amyloidosis, some renal anomalies)
- The physician will inquire about the health of the patient's parents, brothers, sisters and children
- A family history of kidney failure or polycystic kidney disease may be relevant to the underlying problem



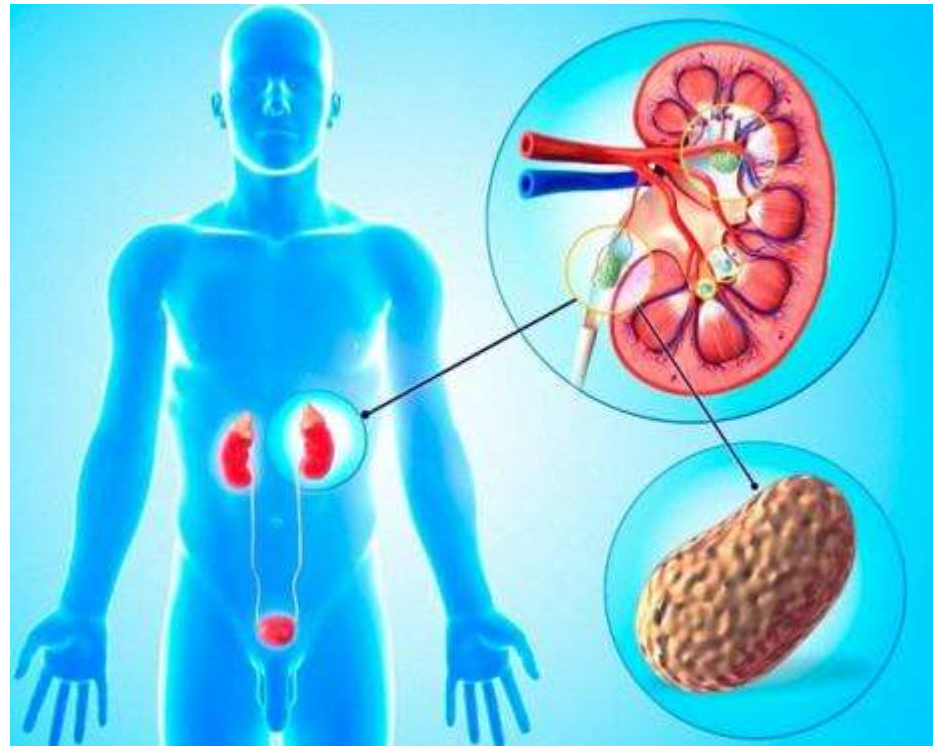
Interviewing of the patient: diet history

- A diet history is important when assessing kidneys illnesses
- Many conditions demand dietary recommendations



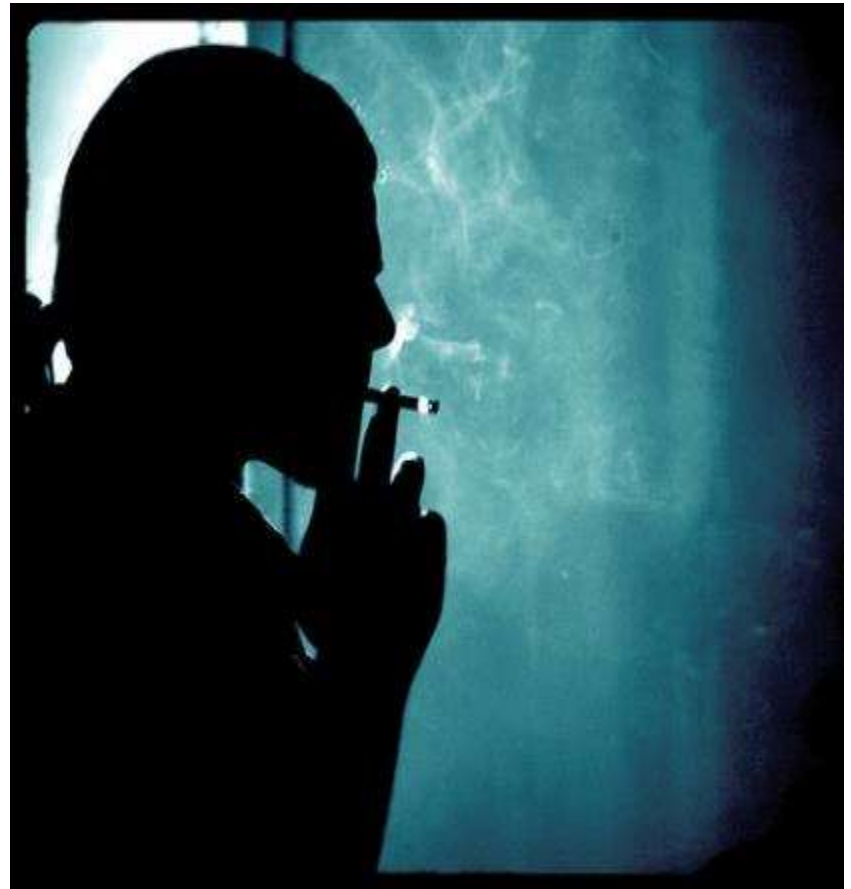
Interviewing of the patient: foreign travel

- Travel to Egypt or Africa may result in exposure to schistosomiasis
- Dehydration during a holiday in a hot climate may lead to the development of kidney stones



Interviewing of the patient: social history

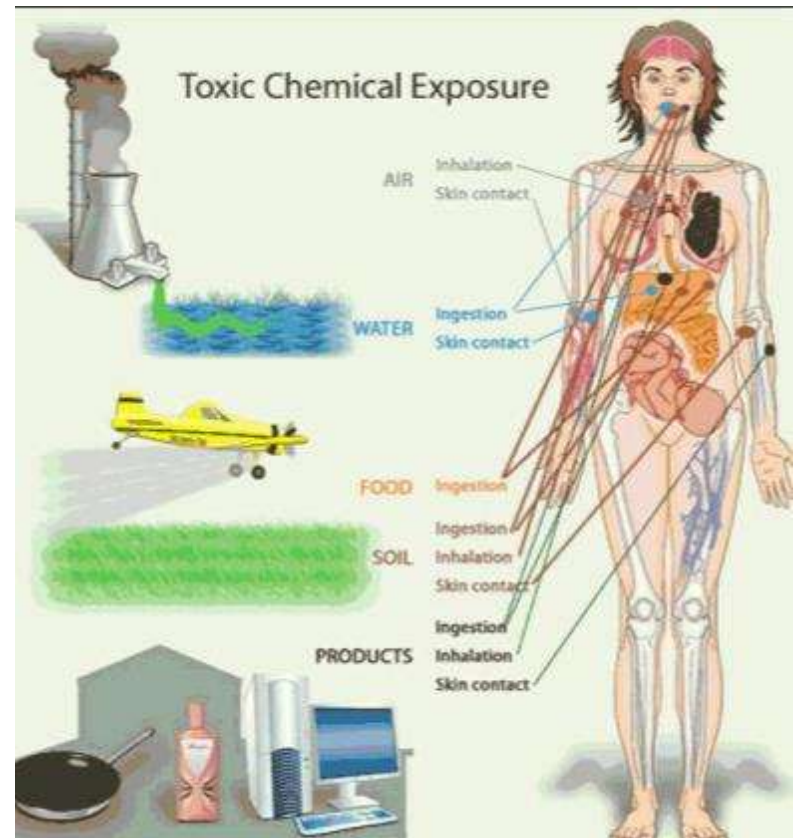
- High-risk behaviors
 - Alcohol, tobacco, or drug abuse
 - Depression
 - Violence
 - Sedentary lifestyle
- Signs of any of the above behaviors may warrant referral to a secondary provider



Interviewing of the patient: chemical or environmental toxin exposure in occupational or other settings

Acute tubular necrosis and following acute renal insufficiency can be caused by intentional (or by mistake) exposure in industrial or domestic poisoning, such as:

- Corrosive sublimate
- Preparations of bismuth
- Phosphorus
- Silver
- Large doses of sulpha preparations



Interviewing of the patient: why take a medical history?

- Up to 90% of conditions can be accurately diagnosed or recognized by conducting a thorough medical history and listening carefully to the patient's response(s)
- Determines the necessary tests and measures you should prioritize for your objective examination



Interviewing of the patient: review of systems

- The "laundry list" of symptoms related to various organs of the body
- A series of questions helps seek out information that the patient may have neglected to provide the physician
- Review of systems helps to identify the patient's problem, or exclude different parts of the differential diagnosis



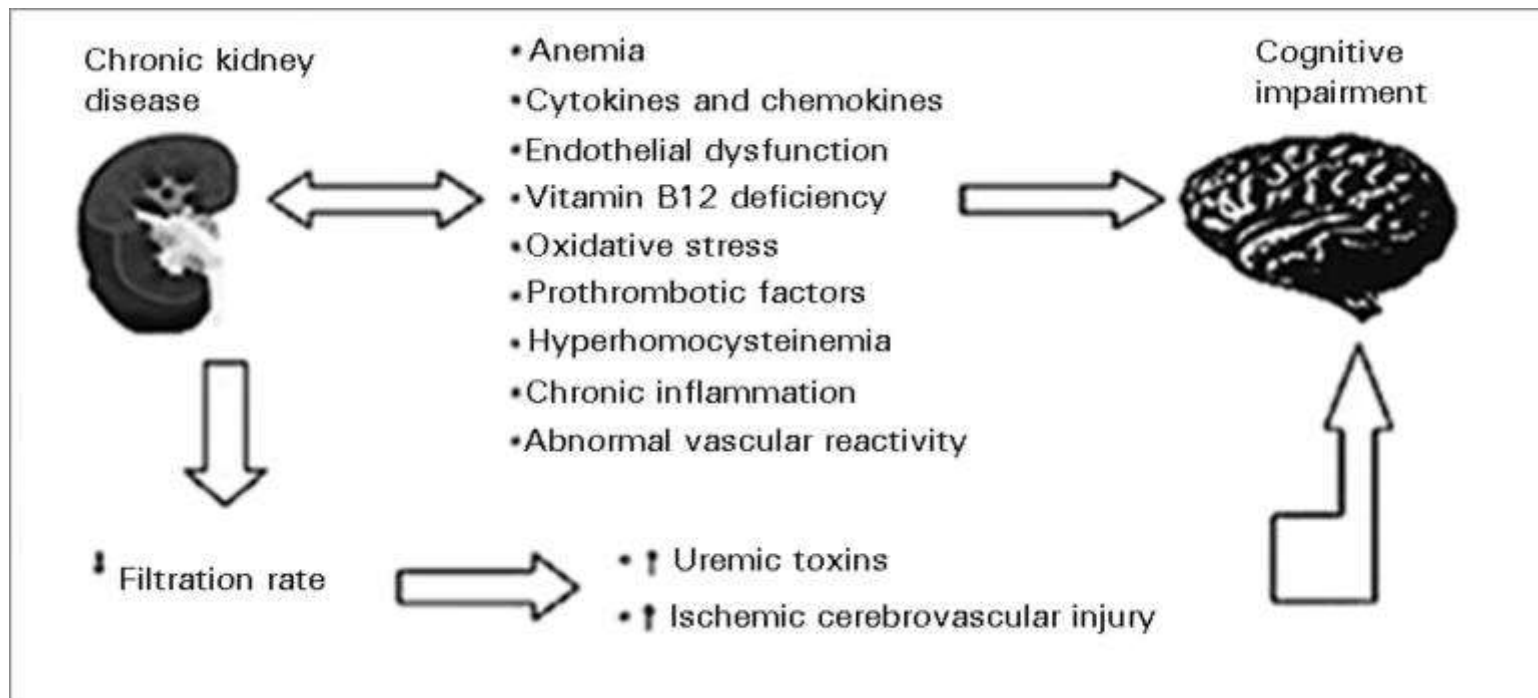
Interviewing of the patient: systemic enquiry

- General: fever, weight loss, loss of appetite, lethargy
- Respiratory and cardiovascular systems: shortness of breath, cough, hemoptysis, wheeze, chest pain
- Gastrointestinal system: nausea and vomiting, hematemesis, dysphagia, heartburn, jaundice, abdominal pain, change in bowel habit, rectal bleeding, tenesmus (sensation of incomplete bowel emptying)
- Gynecological system: pelvic pain, vaginal bleeding, vaginal discharge, LMP
- Neurological system: headaches, dizziness, loss of consciousness, fits, faints, funny turns, numbness, tingling, weakness, problems speaking, change in vision

Interviewing of the patient: Kidney Disease Quality of Life Indexes

- The Kidney Disease Quality of Life Index is a questionnaire which measures Quality of Life these type of patients
- Index is a multidimensional constructs with several dimensions: emotional or psychological well being, physical functioning, social functioning, and symptoms of the disease and treatment
- A single item is also included that identifies perceived change in health, making the Indexes a useful indicators for change in Kidney Disease Quality of Life Indexes over time and treatment

Physical examination of the patient: general level of consciousness



- The patient's general level of consciousness and level of alertness must be assessed, noting deficits in concentration, thought processes, or memory
- Family members may report subtle changes
- Such cognitive changes may be the result of an insufficient clearance of waste products when renal disease is present

Physical examination of the patient: general inspection

- Whether patient is comfortable at rest
- Do patient appears to be tachypnoeic
- Are there any obvious patient' skin color changes
- Are there any obvious medical appliances around the bed (such as patient controlled analgesia)
- Are there any medications around (although this is unlikely as all medications should be in a locked cupboard)



Physical examination of the patient: general inspection

- The patient's posture in bed: active, passive (uraemic coma), forced (paranephritis, renal colic, uraemic coma, renal eclampsia, etc.)
- Oedema (an acute and chronic glomerulonephritis, nephrotic syndrome, kidneys' amyloidosis) with pallid, swollen (oedematous eyelids, narrowed eyes) face (nephritica), and in more pronounced cases with extremities and trunk (anasarca) swelling
- Pallid oedematous skin in chronic nephritis due to the spasm of arterioles, and anaemia which attends kidney disease
- Wax pallid skin can be detected in amyloidosis and lipoid nephrosis
- Scratches on the skin and coated dry tongue can be found in a patient with chronic nephritis
- An unpleasant odour of ammonia can be felt from the mouth and skin of the patient (factor uremicus)
- Lymphadenopathy; lymph nodes may be enlarged due to metastatic spread from any urological cancer

Physical examination of the patient: the patient's posture in bed



Renal colic

Physical examination of the patient: face nephritica



Physical examination of the patient: extremities swelling



Physical examination of the patient: anasarca



Physical examination of the patient: pallid oedematous skin



Physical examination of the patient: scratches on the skin



Physical examination of the patient: lymphadenopathy



Physical examination of the patient: abdominal investigation

- Abdomen may be distended due to large polycystic kidneys or ascites due to nephritic syndrome or nephrotic syndrome
- The kidneys are examined bimanually with a hand posteriorly lifting up the kidney towards the examining abdominally placed hand
- Tenderness over the kidney should be tested by gentle pressure over the renal angle
- Palpation for renal enlargement or masses (an enlarged kidney usually bulges forwards; in polycystic kidney disease, there may also be hepatomegaly from hepatic cysts)
- Percussion for the presence of ascites (shifting dullness) and for an enlarged bladder
- Auscultation for a renal bruit in renal artery stenosis (heard above the umbilicus, 2 cm to the left or right of the midline and also in both flanks with the patient sitting up)

Physical examination of the patient: the kidneys are examined bimanually

- Reach one hand round to the patient's right loin with your other hand over the right upper quadrant
- Push your hands together whilst asking the patient to breathe in and out
- Try to palpate any enlarged kidney between your two hands (called 'balloting').
- Repeat for the left kidney
- Examine for enlarged kidneys, renal masses or loin tenderness



Physical examination of the patient: percussion for the presence of ascites

- Ask the patient or an observer to place their hand longitudinally over the center of the abdomen
- Place your right hand on the left side of the abdomen and your left hand opposite, so that both are equidistant from the umbilicus
- Firmly tap on the abdomen with your right hand while your left remains against the abdominal wall
- If there is a lot of ascites present, you may be able to feel a fluid wave (generated in the ascites by the tapping maneuver) strike against the abdominal wall under your left hand



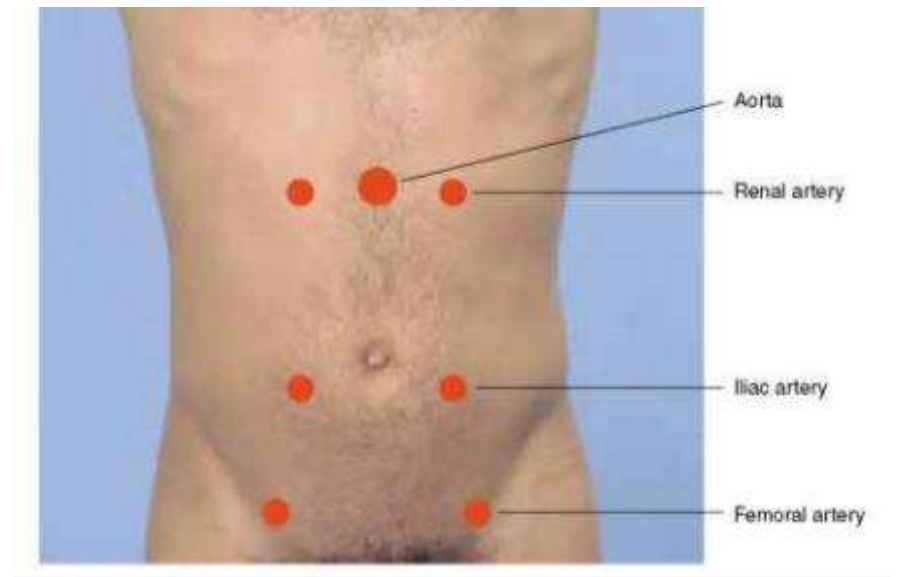
Physical examination of the patient: percussion for the urinary bladder

- Percuss your patient's bladder, beginning over symphysis pubis and working toward umbilicus
- A urine-filled bladder produces a dull sound
- A change to tympany indicates the bladder's border



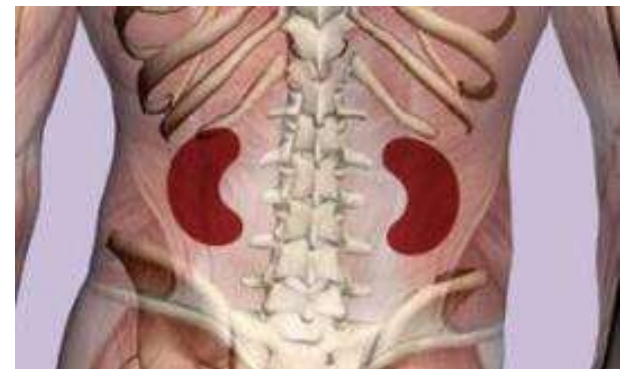
Physical examination of the patient: auscultation for a renal bruit

- Subcostal bruit suggests renal artery stenosis
- Hearing a bruit over the left upper quadrant suggests left renal artery stenosis, carcinoma of the body or tail of the pancreas, massive splenomegaly, and splenic artery stenosis or dissection



Physical examination of the patient: percussion of the kidneys

- Assist the client to a sitting position, and stand behind the client
- For indirect percussion, place the palm of your monodominant hand over the costovertebral angle
- Strike this area with the ulnar surface of your dominant hand, curled into a fist
- For direct percussion, also strike the area over the costovertebral angle with the ulnar surface of your dominant hand, curled into a fist
- Repeat the technique for the other kidney
- You should do percussion of the kidneys with only enough force so the client feels a gentle thud

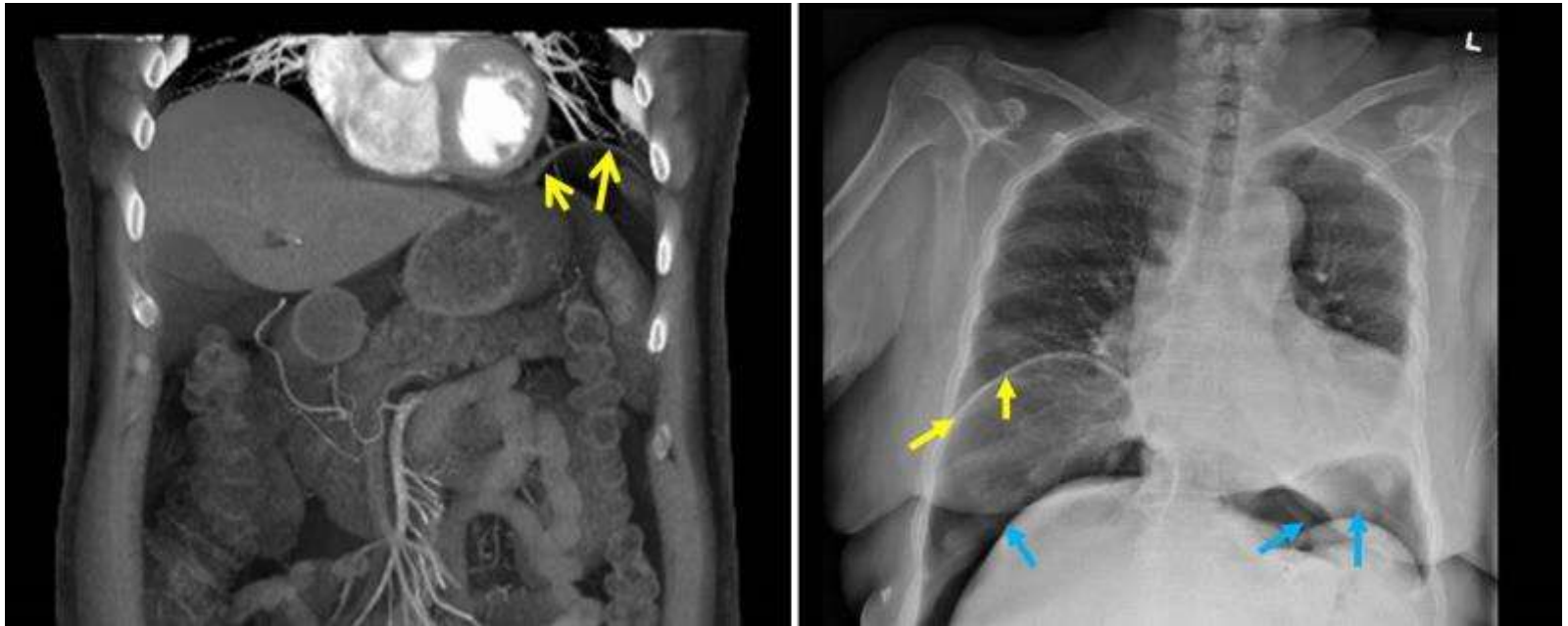


Physical examination of the patient: interpretation of percussion of the kidneys

- If the patient feels pain, the symptom is defined as costovertebral angle tenderness (Murphy's punch sign)
- The symptom is positive in pyelonephritis (inflammation of the kidney and upper urinary tract), nephrolithiasis (renal stone), paranephritis (inflammation of the connective tissue around the kidney, perinephric abscess), inflammation of pelvis, myositis and radiculitis

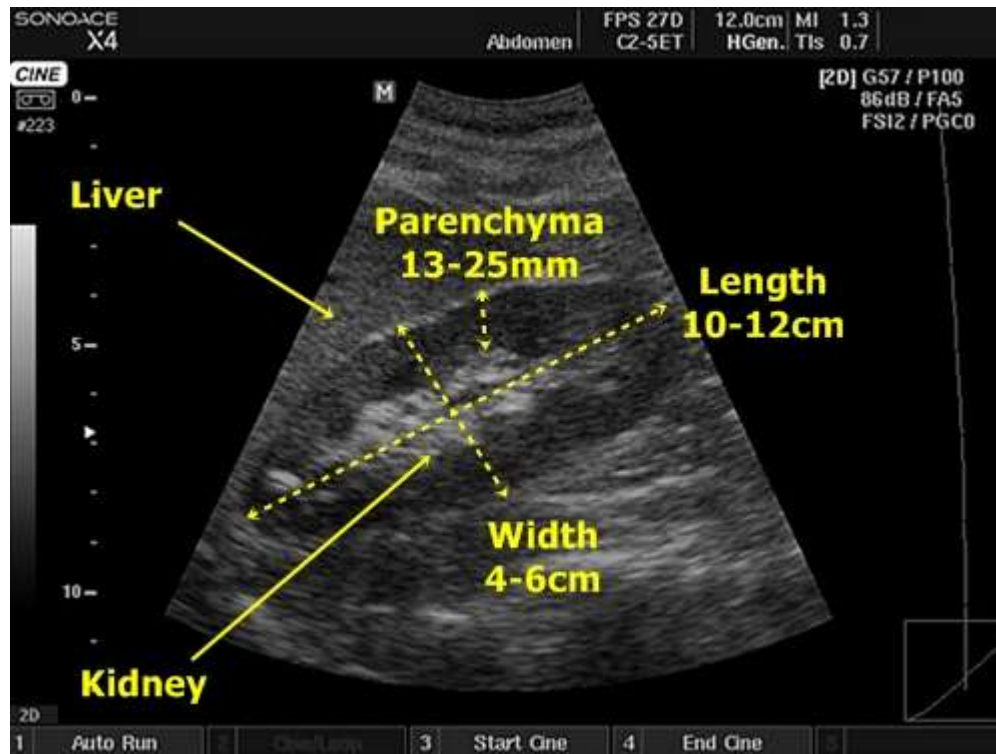


Instrumental methods: flat-plate film of the abdomen



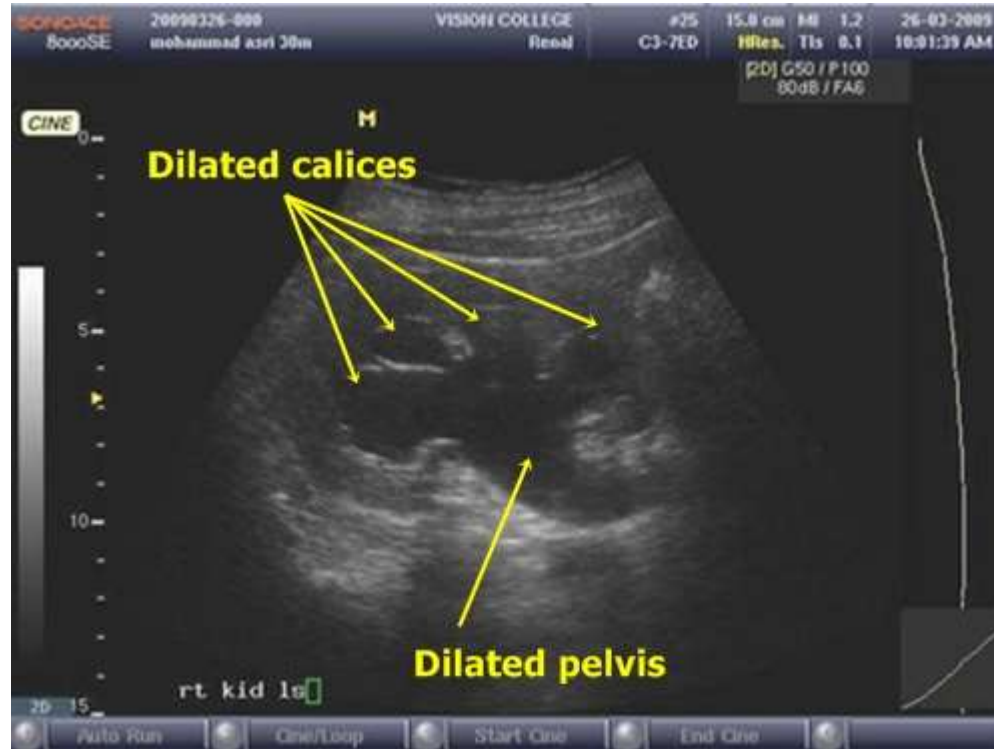
These two radiographs show the importance of including the diaphragm on the plain-film abdomen x-ray

Instrumental methods: renal sonography



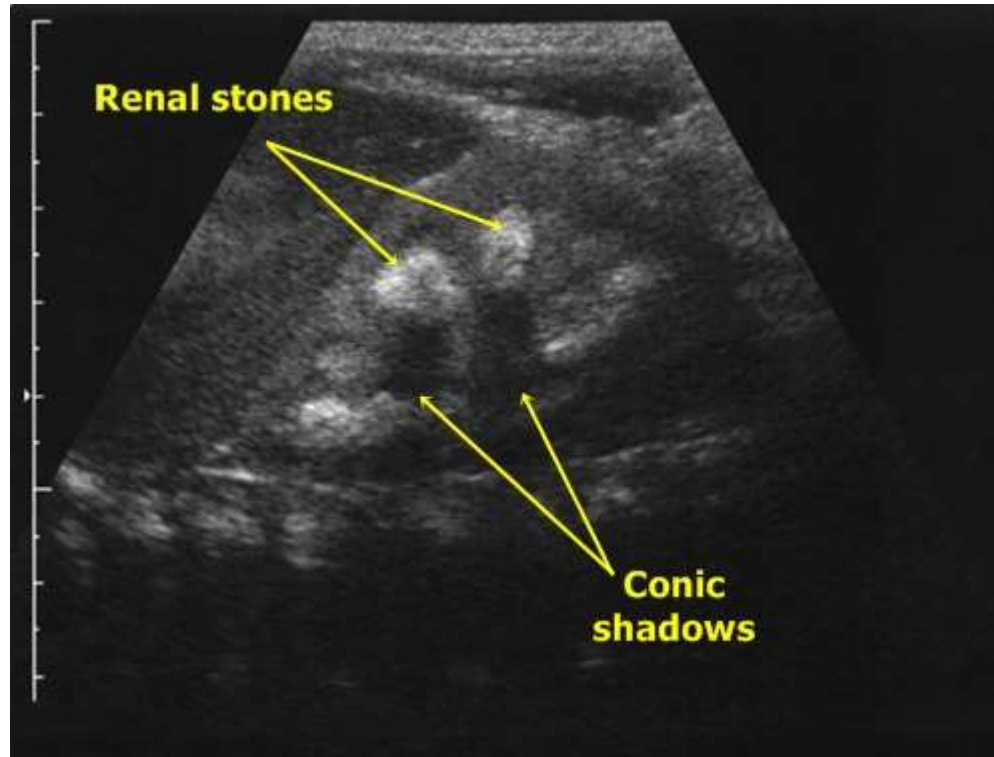
Longitudinal cut through the right kidney with marked proportions
Neighbouring liver tissue is brighter than renal parenchyma and therefore probably steatotic

Instrumental methods: renal sonography



Hydronephrosis- In this picture dilatation of the pelvis and calices is visible

Instrumental methods: renal sonography



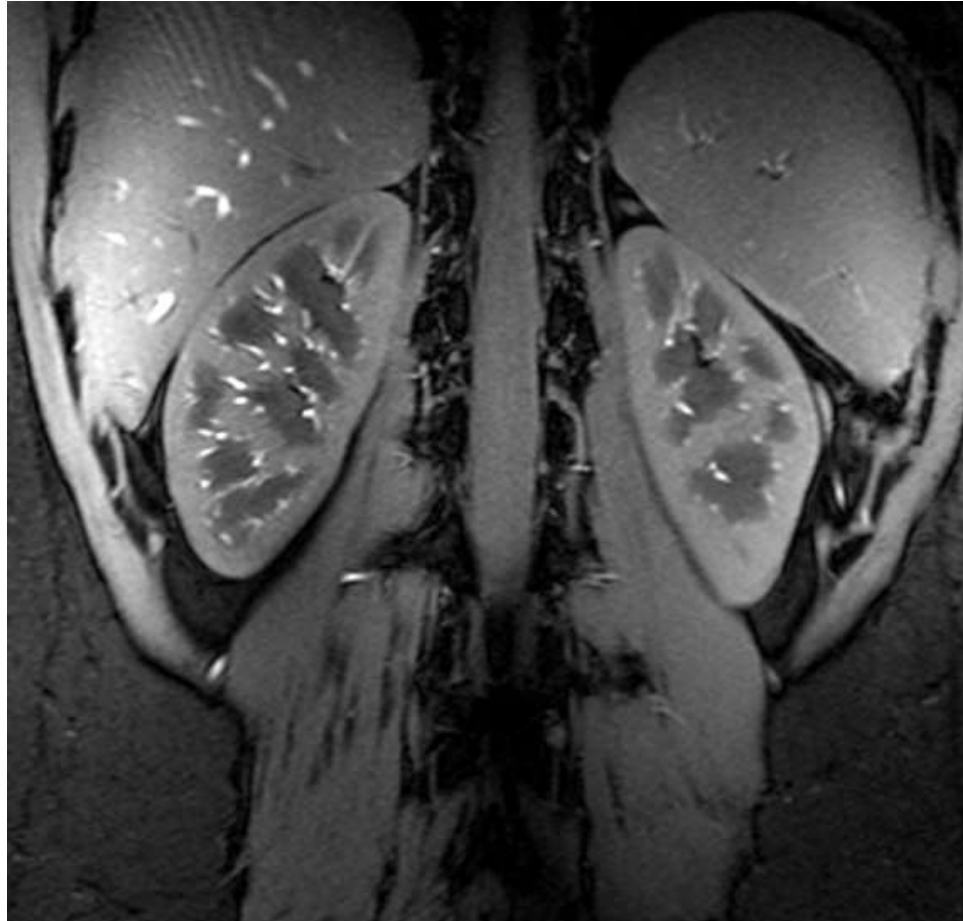
Nephrocalcinosis - two concrements (marked by red circles), which cannot be well distinguished from the hyperechogenic center of the kidney

Instrumental methods: renal color Doppler



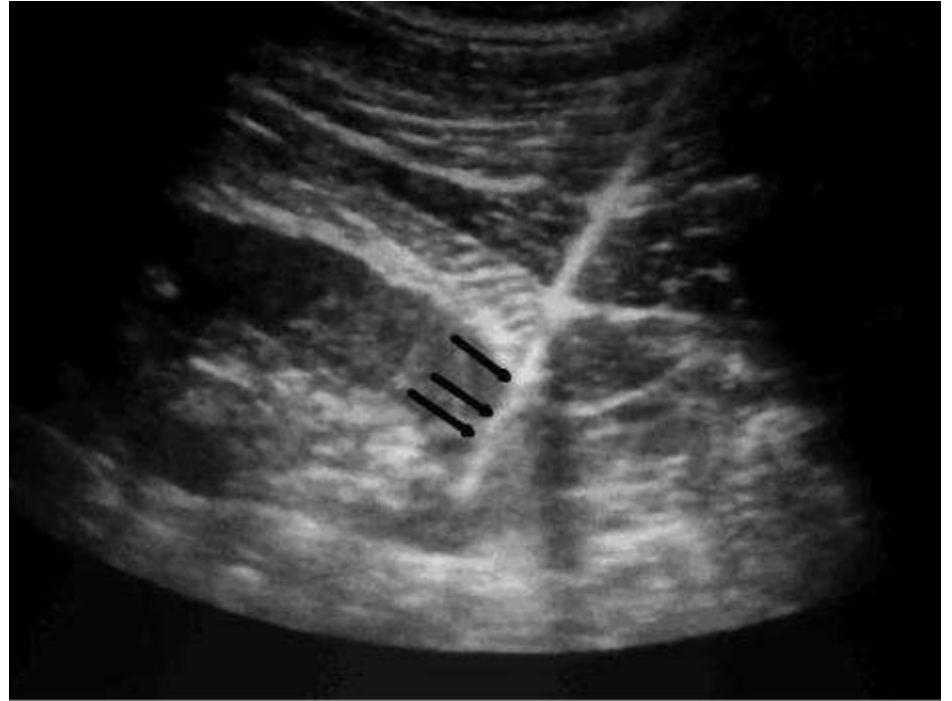
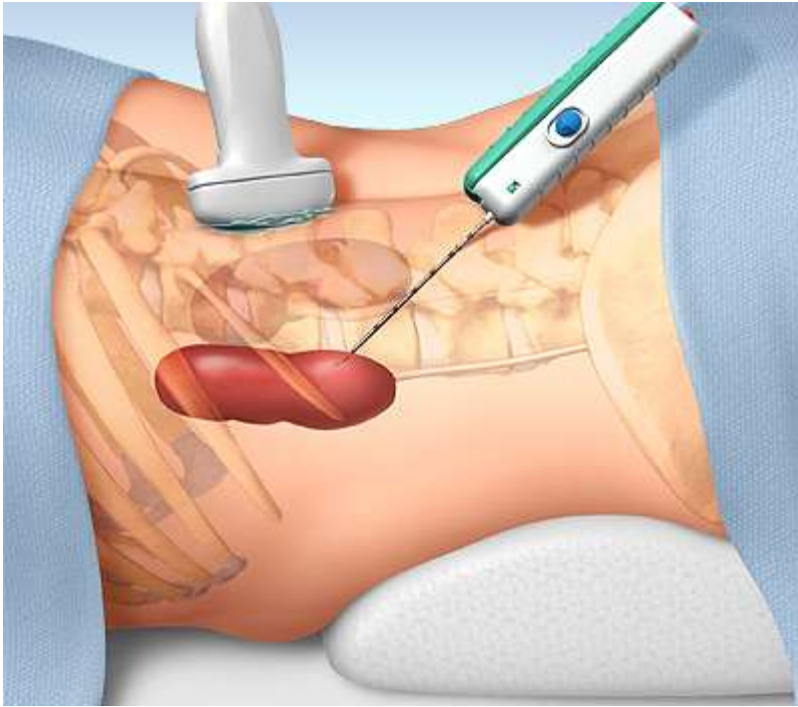
Normal renal arteries and renal veins

Instrumental methods: renal sonography



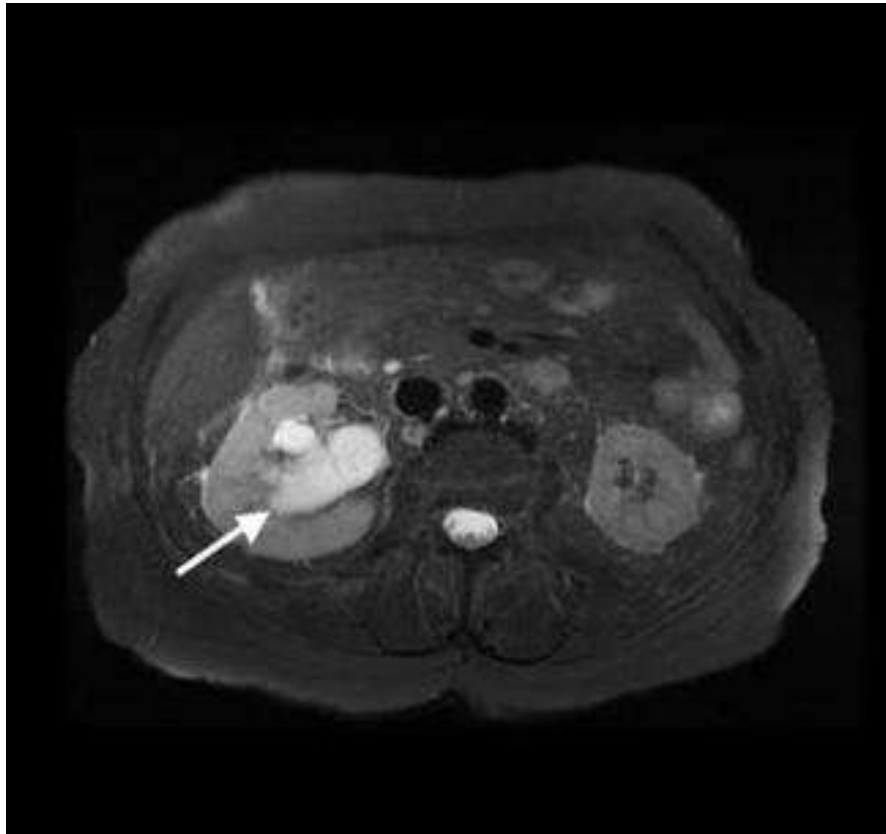
A high resolution gradient echo anatomic image of the kidneys

Instrumental methods: renal ultrasound biopsy



Ultrasound image showing the biopsy gun inside the lower pole of the kidney (arrows)

Instrumental methods: magnetic resonance imaging (MRI)



Contrast-enhanced MRI through the abdomen after cryoablation. The renal cell carcinoma has been fully treated

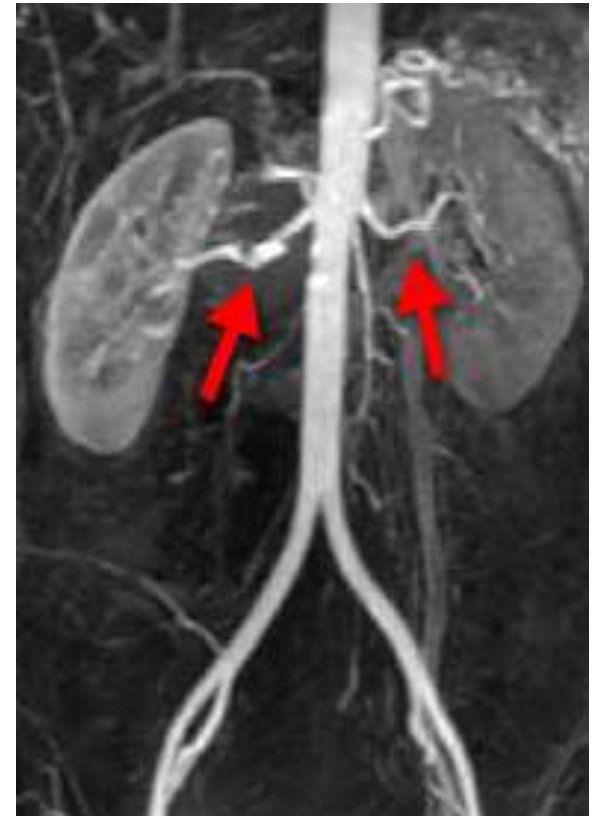
Instrumental methods: magnetic resonance imaging (MRI)



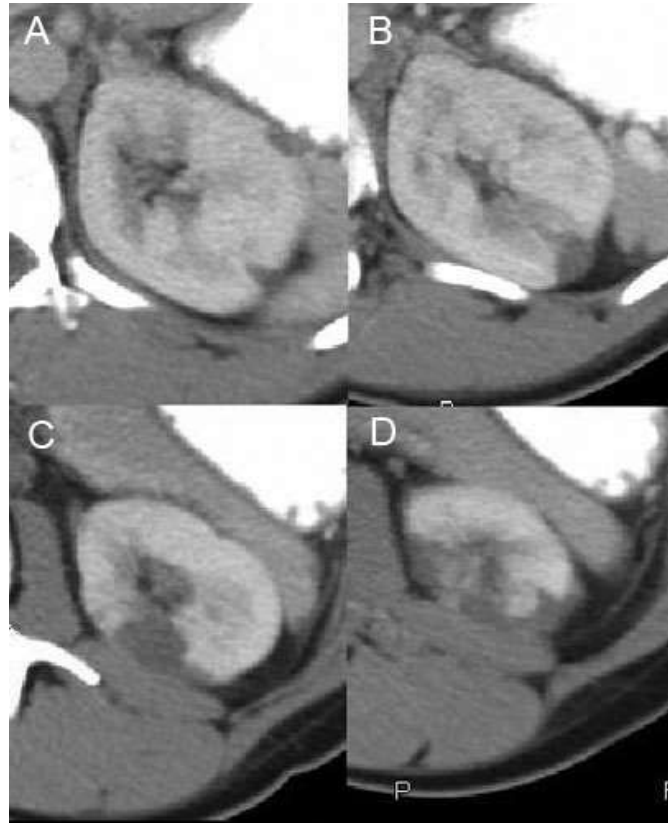
Multiple bilateral renal microcysts

Instrumental methods: magnetic resonance angiography (MRA)

- MRA stands for Magnetic Resonance Angiography
- It is an magnetic resonance imaging (MRI) technique that specifically evaluates vessels such as arteries
- Renal artery MRAs evaluate the vessels that supply blood to the kidneys to look for narrowing and blockage of the vessels, evaluate a suspected aneurysm, or look at the blood supply of a kidney tumor

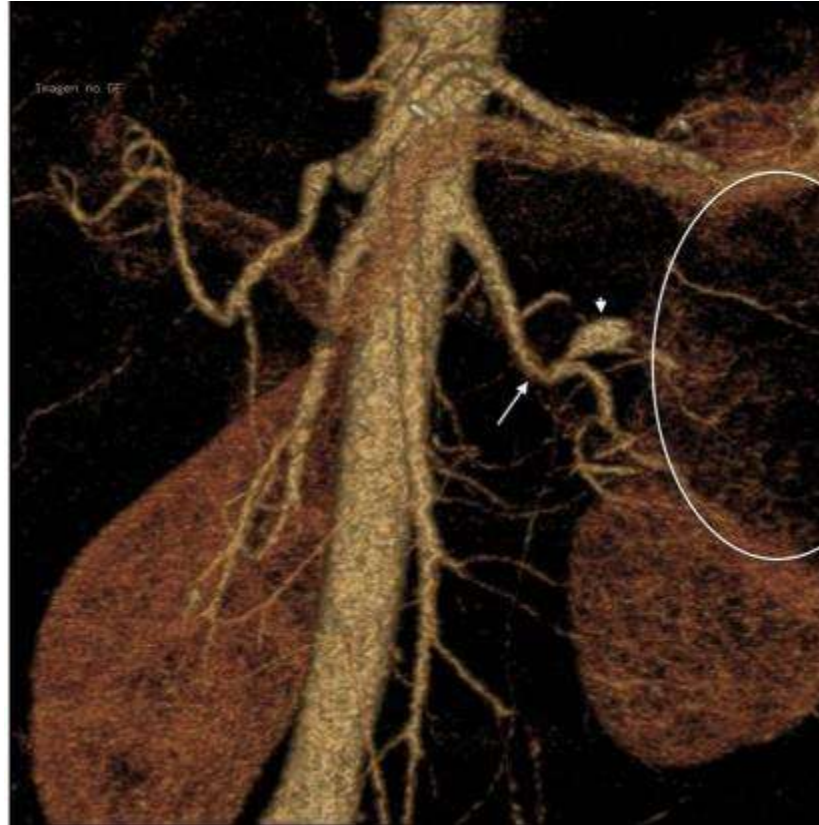


Instrumental methods: computer tomography



Acute renal infarction

Instrumental methods: computed tomography



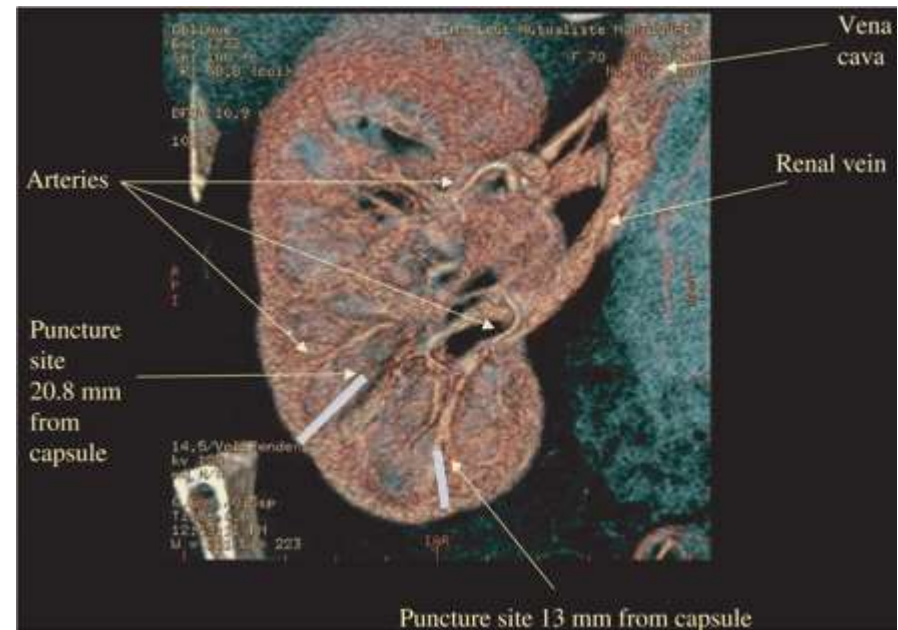
CT reconstruction of abdominal aorta showing mild stenosis before bifurcation of the left renal artery (oblique arrow), an aneurysm of a superior polar branch (arrow head) and a left kidney superior pole infarct (ellipse)

Instrumental methods: renal biopsy

A biopsy may be done occasionally for one of the following reasons:

- to identify a specific disease process and determine whether it will respond to treatment
- to evaluate the amount of damage that has occurred in the kidney
- to find out why a kidney transplant may not be doing well

A kidney biopsy is performed by using a thin needle with a sharp cutting edge to slice small pieces of kidney tissue for examination under a microscope



Transjugular renal biopsy. Three-dimensional computed tomography .

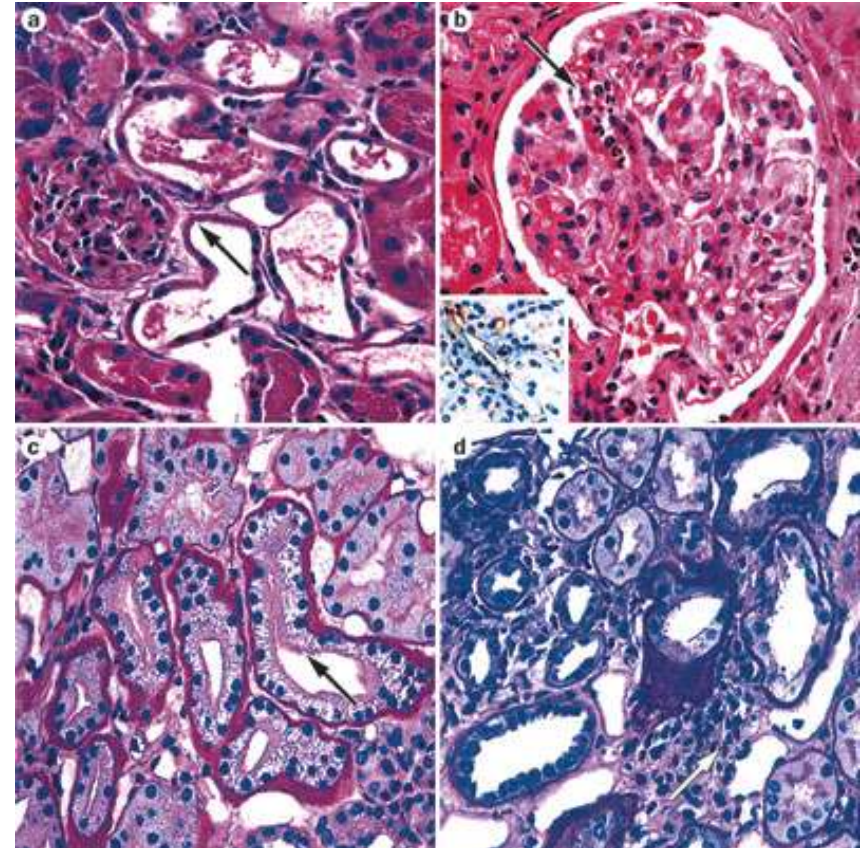
Instrumental methods: renal biopsy

a Acute tubular injury, with loss of brush borders and nuclei in proximal tubules (arrow) and little infiltrate

b Hyperacute rejection, with neutrophils in glomerular capillaries (arrow)

c Acute tubulopathy resulting from the toxic effects of calcineurin inhibitors, with characteristic isometric vacuolization (arrow)

d Urine leaks that cause obstruction typically demonstrate only a focal infiltrate (arrow), but can mimic acute cellular rejection



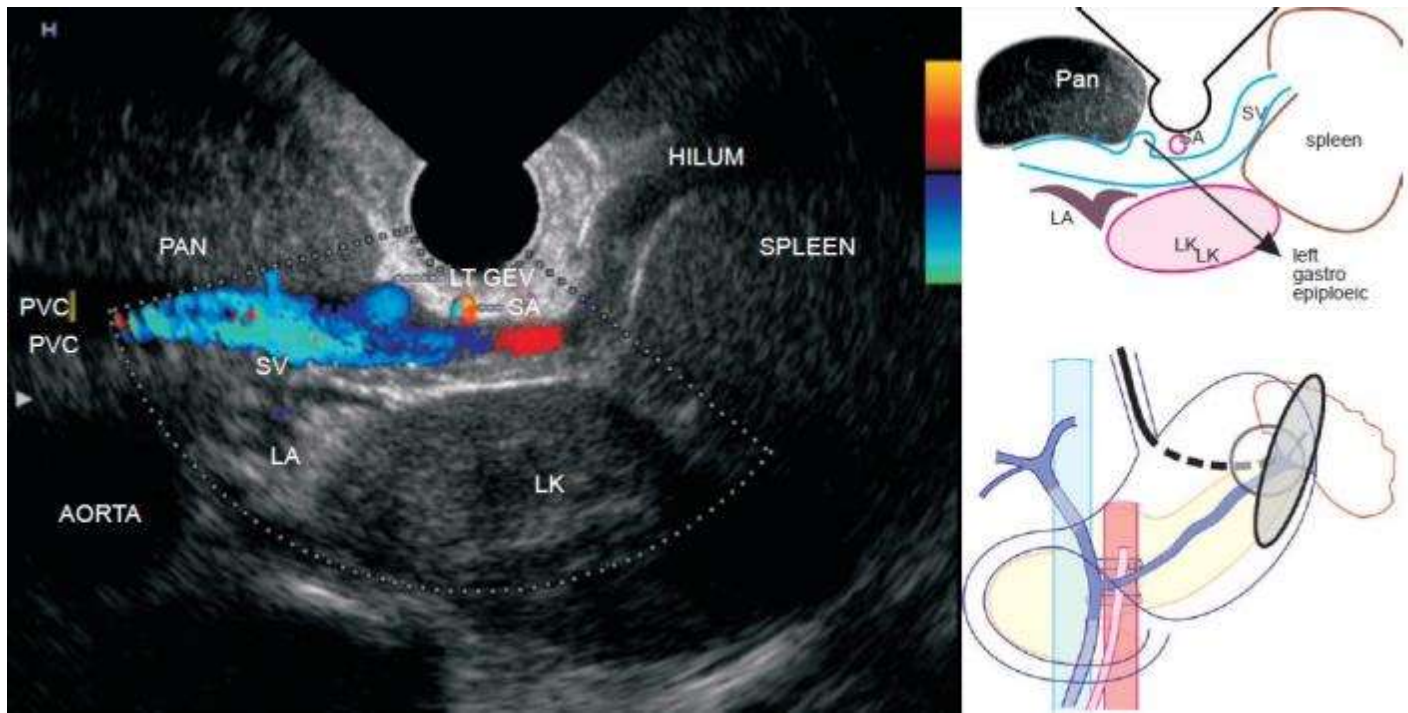
Pathological findings in renal biopsy samples taken 0–3 days after transplantation

Instrumental methods: angiography



Right renal angiography showing stenosis (small arrow) and an aneurysm (large arrow) of a medial branch near the renal hilum

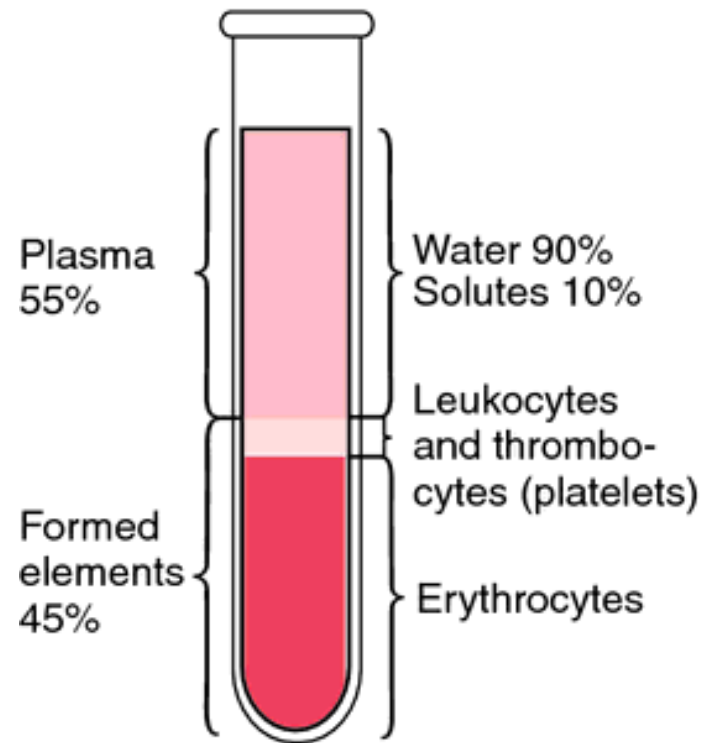
Instrumental methods: endoscopic ultrasonography



The spleen is enlarged and the splenic vein is seen taking the course anterior to the left kidney (5 o'clock)

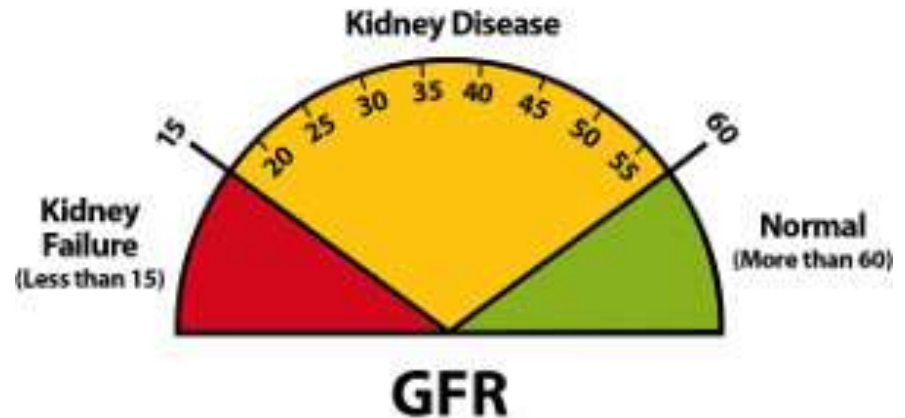
laboratory methods: Blood Tests

- Serum creatinine , glomerular filtration rate (GFR)
- Blood Urea Nitrogen (BUN)
- Hemoglobin in the blood
- Erythropoietin in the blood
- Electrolytes (sodium, potassium, chloride and bicarbonate)
- Parathyroid hormone (PTH), which controls calcium levels, is often increased in kidney disease
- Antinuclear antibody (ANA) in identifying an autoimmune condition such as lupus



laboratory methods: Blood Tests (glomerular filtration rate)

- Glomerular filtration rate (GFR) is the volume of fluid filtered from the kidney glomerular capillaries into the Bowman's capsule per unit time
- The GFR is typically recorded in units of volume per time, e.g., milliliters per minute mL/min
- In clinical practice the serum creatinine level is used to measure GFR

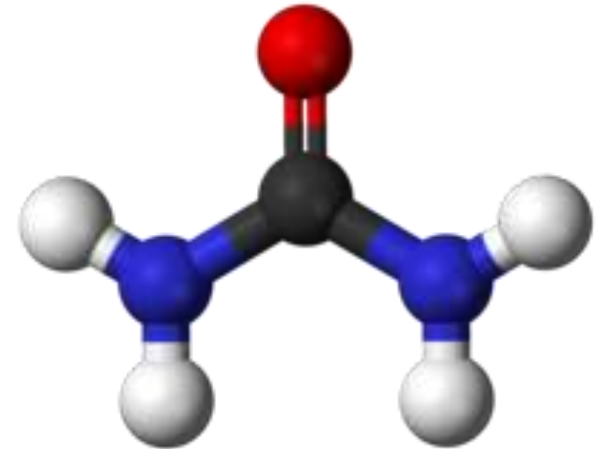


Chronic Kidney Disease stage	GFR level (mL/min/1.73 m ²)
1	≥ 90
2	60 – 89
3	30 – 59
4	15 – 29
5	< 15

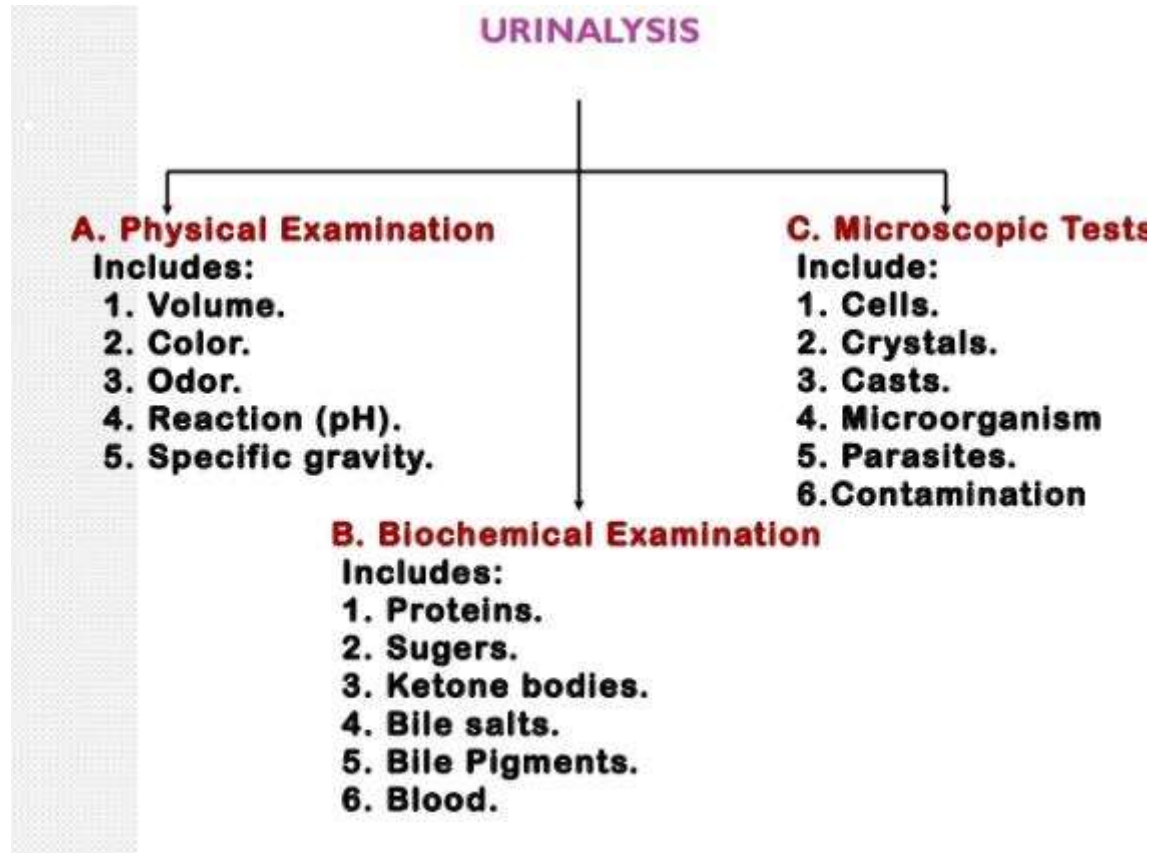
laboratory methods: Blood Tests

(Blood Urea Nitrogen)

- The liver produces urea in the urea cycle as a waste product of the digestion of protein
- Normal human adult blood should contain between 6 to 20 mg of urea nitrogen per 100 ml (6–20 mg/dL) of blood
- Blood urea nitrogen (BUN) is an indication of renal (kidney) health
- Normal ranges 1.8-7.1 mmol/L.
- The main causes of an increase in BUN are: high protein diet, decrease in glomerular filtration rate (GFR) (suggestive of renal failure) and in blood volume (hypovolemia), congestive heart failure, gastrointestinal hemorrhage, fever and increased catabolism



laboratory methods: urinalysis



The above urine chart can only give you an idea how the urine color can change in dehydration, but it is NOT a reliable tool to judge in which stage of dehydration you are

laboratory methods: urinalysis (volume)

- Polyuria – more than 2,000 ml/24-hours (diabetes mellitus type II and type I, diabetes insipidus, certain tumors of brain and spinal cord, acromegaly, myxedema, and certain kidney diseases, nonpathologic cause is usually increased fluid intake)
- Oliguria - which is a reduction in the total volume of urine excreted -less than 500 ml/24-hours (febrile states, excessive vomiting, severe diarrhea, or extreme dehydration, nonpathologic causes are decreased fluid intake and excessive sweating)
- Anuria - this term literally means "no urine" and refers to a complete lack of urine excretion



laboratory methods: urinalysis (color)



- Normal urine color results from a various pigments which are collectively referred to as urochrome
- The various shades of yellow in urine specimens vary with the intensity of the urochrome present and with the specific gravity
- Urine can show a typical coloration because of pathological conditions and as a result of the ingestion of certain substances, including food pigments, dyes, drugs, and so forth

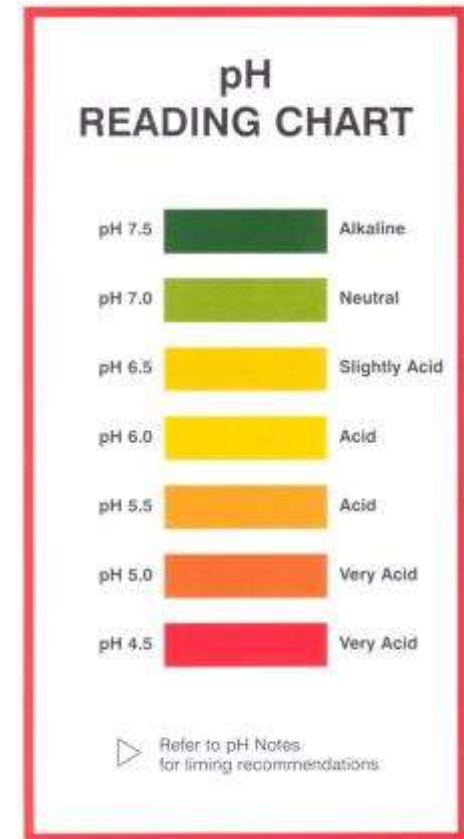
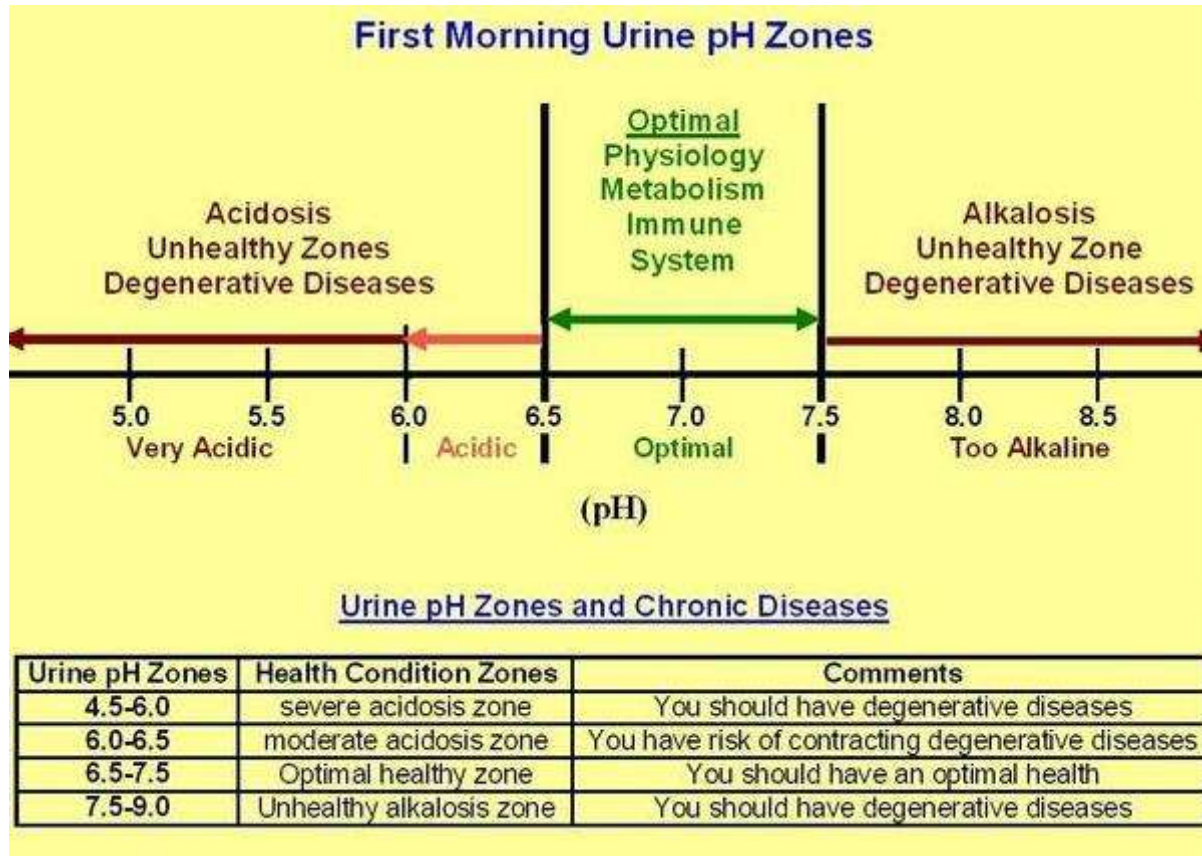
laboratory methods: urine color chart

Urine Color	Possible Meaning
Clear	Good hydration, overhydration or mild dehydration
Pale Yellow	Good hydration or mild dehydration
Bright Yellow	Mild or moderate dehydration or taking vitamin supplements
Orange, Amber	Moderate or severe dehydration
Tea-Colored	Severe dehydration

The above urine chart can only give you an idea how the urine color can change in dehydration, but it is NOT a reliable tool to judge in which stage of dehydration you are

laboratory methods: urinalysis

(reaction (pH))



laboratory methods: urinalysis (specific gravity)

- Specific gravity measures the kidney's ability to concentrate urine
- Specific gravity is a comparison of the density of urine to the density of distilled water, which is regarded as 1.000
- Generally, the greater the volume of urine excreted, the lower the specific gravity
- There is considerable variation in the specific gravity range of 1.003 to 1.030



Clinical refractometers

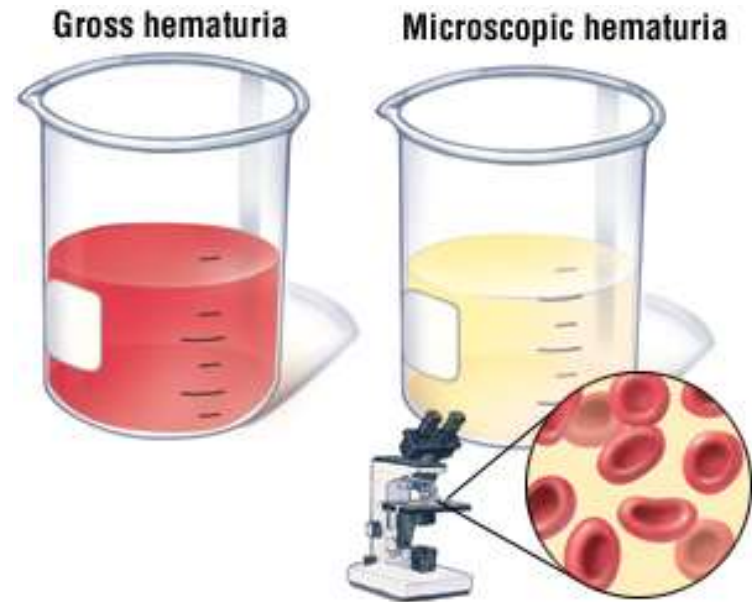
laboratory methods: urinalysis

(microscopic tests: cells and microorganisms)

- Cells, crystals, and other substances are counted and reported either as "none," "few," "moderate," or "many"
- Red Blood Cells (RBCs): normally, a few RBCs are present in urine sediment; inflammation, injury, etc. can cause RBCs to leak out of the blood vessels into the urine
- White Blood Cells (WBCs): the number of WBCs in urine sediment is normally low; when the number is high, it indicates an infection or inflammation somewhere in the urinary tract
- Epithelial Cells: normally, a few epithelial cells from the bladder or from the external urethra can be found in the urine sediment; in urinary tract conditions more epithelial cells are present
- Microorganisms (bacteria, yeasts) and parasites: in health, the urinary tract is sterile; bacteria from the surrounding skin can enter the urinary tract at the urethra and move up to the bladder, causing a urinary tract infection (UTI)

laboratory methods: urinalysis (microscopic tests: hematuria)

- Hematuria may be grossly visible (macroscopic hematuria) or detectable only on urine examination (microscopic hematuria)
- Gross hematuria, or macroscopic hematuria, is defined as blood that can be seen with the naked eye
- Microscopic hematuria is defined as the presence of more than 3 red blood cells (> 3 RBC) per high power field (HPF) in the centrifuged urinary sediment



laboratory methods: urinalysis (microscopic tests: leukocytes)

- Normally there are up to 0-2 leukocytes per high power field (HPF) or 10 per microliter (μl) or mm^3
- Pyuria (the pus in urine) is defined as the presence of > 10 leucocytes per microliter (μl) or mm^3 , and it can be sign of a bacterial urinary tract infection
- Sterile pyuria is the presence of elevated numbers of white cells (>10 white cells/ mm^3) in urine which appears sterile using standard culture techniques



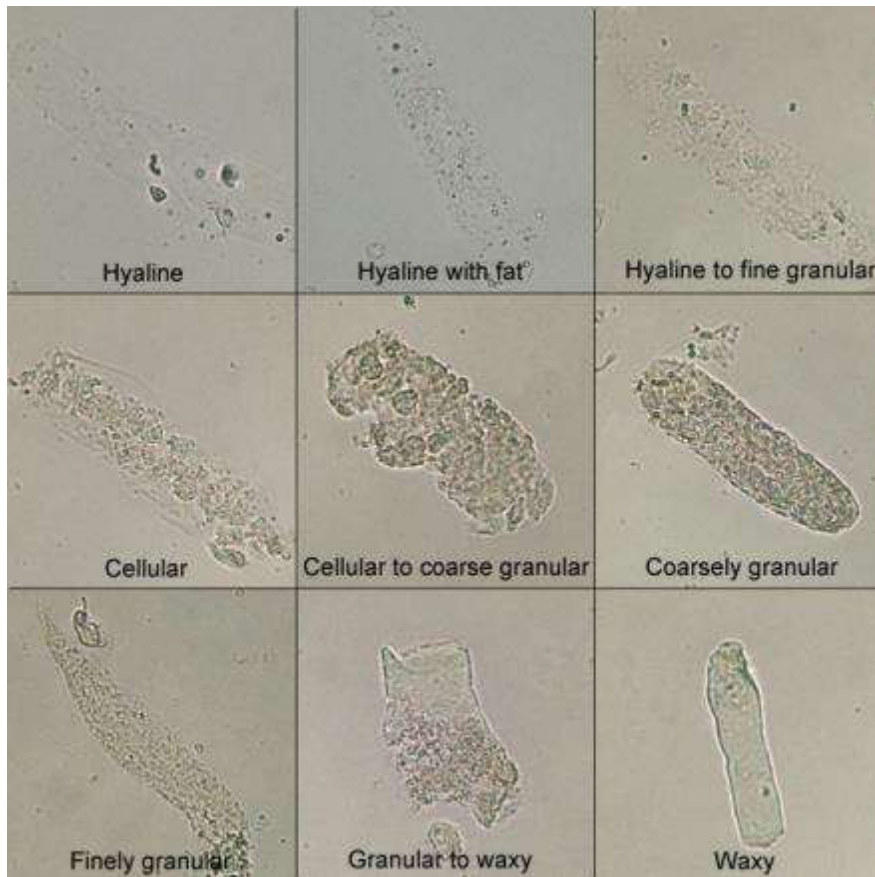
laboratory methods: urinalysis

(microscopic tests: casts and crystals)

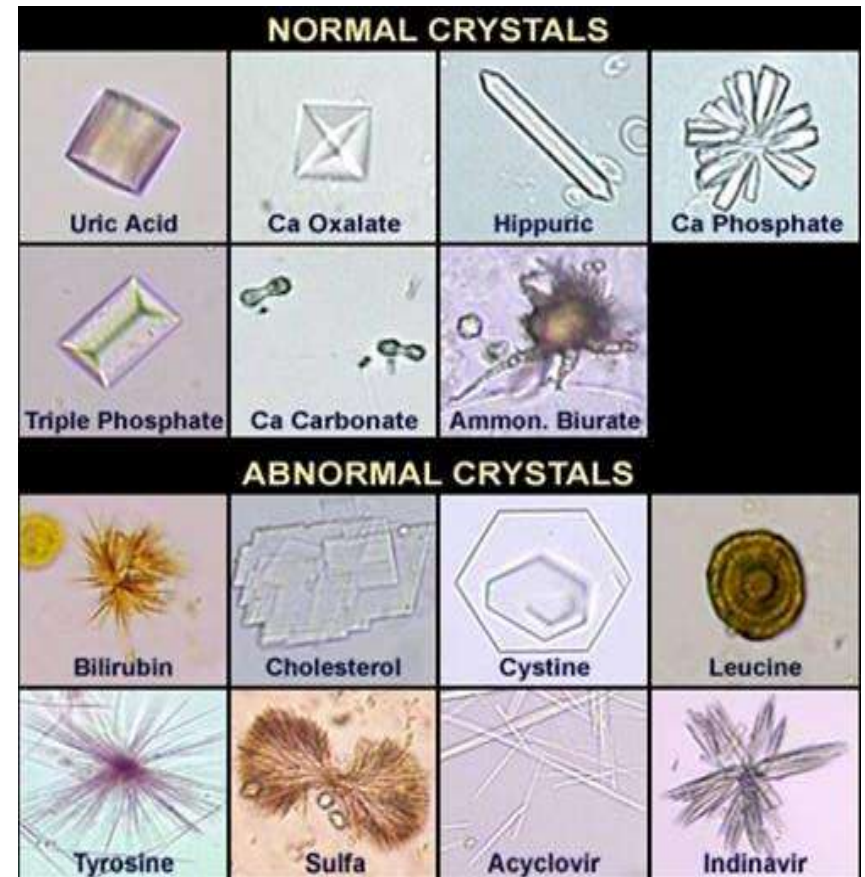
- Casts (cylindrical particles, they are formed from protein in the long, thin, hollow tubes of the kidneys known as tubules and usually take the shape of the tubule (hence the name)): normally, healthy people may have a few (0–5) hyaline casts per low power field (LPF); in the kidneys diseases, the cast is identified by the substances inside it, for example, as a red blood cell cast or white blood cell cast; different types of casts are associated with different kidney diseases
- Crystals: crystals are identified by their shape, color, and by the urine pH; crystals are considered "normal" if they are from solutes that are typically found in the urine (amorphous urates, crystalline uric acid, calcium oxalates, amorphous phosphates, calcium carbonate); if the crystals are from solutes that are not normally in the urine, they are considered "abnormal"; abnormal crystals may indicate an abnormal metabolic process and some of these include cystine, tyrosine, leucine; when crystals form as urine is being made in the kidney, they may group together to form kidney "stones" or calculi

laboratory methods: urinalysis

(casts and crystals)



Casts



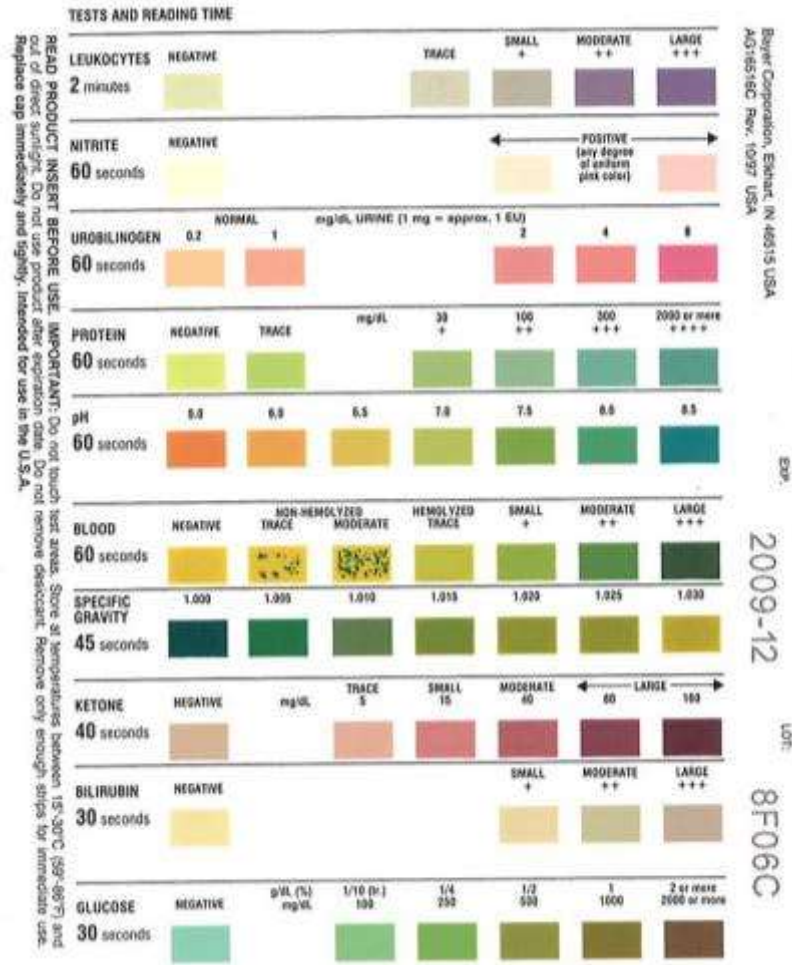
Crystals

laboratory methods: urinalysis (contamination)



Although the colony count is $>100,000$, this growth is considered contamination because more than three colony types are present

laboratory methods: urinalysis (biochemical examination)



Lecture 8

Approach to the patient with affection
and disease of the musculoskeletal
system and connective tissue

Plan of the lecture



Approach to the Patient
with Affection and Disease of the
musculoskeletal system
and connective tissue

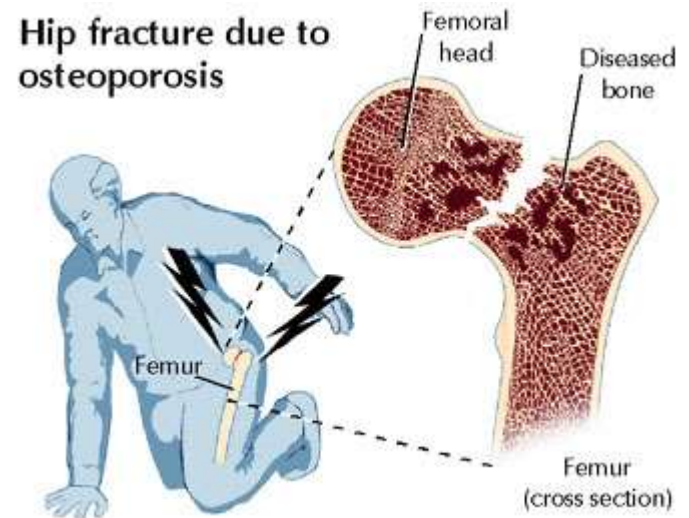
- Musculoskeletal disorders and
Connective tissue diseases
definitions
- Interviewing of the patient
- Physical examination of the patient
- Instrumental methods
- Laboratory methods

Musculoskeletal disorders definition

Musculoskeletal disorders (MSDs) are injuries or pain in the body's joints, ligaments, muscles, nerves, tendons, and structures that support limbs, neck and back

MSDs are degenerative diseases and inflammatory conditions that cause pain and impair normal activities

They can affect many different parts of the body including upper and lower back, neck, shoulders and extremities (arms, legs, feet, and hands)



Connective tissue diseases definition

- A connective tissue disease is any disease that has the connective tissues of the body as a target of pathology
- Diseases in which inflammation or weakness of collagen tends to occur are also referred to as collagen diseases
- Connective tissue diseases can have strong or weak inheritance risks, and can also be caused by environmental factors



Marfan syndrome

Interviewing of the patient: four overlapping processes

1. *engaging* (connecting with patients and establishing a good working relationship)
2. *focusing* (agreeing on the target of motivational enhancement and directing the conversation toward it)
3. *evoking* (drawing out the patients' own motivations for changing the target behavior)
4. *planning* (developing commitment to change and formulating a specific plan of action)



Interviewing of the patient: Good questions to get started on the core interview



Communication skills:

- Active listening
- Empathy
- Building rapport
- Open-ended questions
- Leading questions
- Silence
- “Why” questions
- Nonverbal communication cues

Interviewing of the patient: Good questions to get started on the core interview

- What is your chief complaint?
- Tell me why you're here today
- Tell me about your injury
- What can I do to help you?
- Explain to me your understanding of your injury



Interviewing of the patient: Patient profile

- Age
- Sex
- Race/Ethnicity
- Handedness
- Ht-Wt-BMI-Body type
- Primary language
- Barriers to learning
- Learning preference
- Unique rehabilitation goals

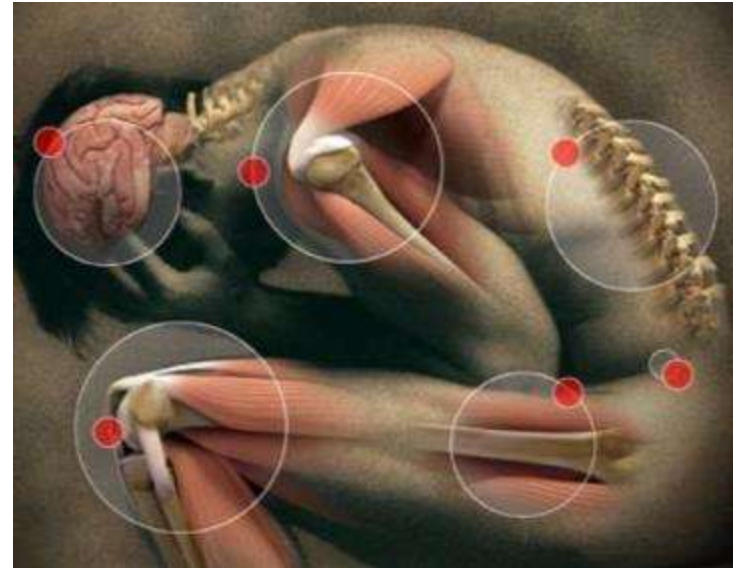


Interviewing of the patient: complaints

- Pain (arthralgia, myalgia, bone pain etc.)
- Joint stiffness
- Joint swelling (synovial hypertrophy +/- effusion)
- Deformity
- Ankylosis
- Muscle weakness
- Limited range of motion
- Bone fractures
- A butterfly-shaped rash on the cheeks and bridge of the nose
- Sensitivity to sunlight
- Hair loss
- Malaise
- Cold and numb fingers or toes (Raynaud's phenomenon)
- Swollen fingers or hands
- Rash
- Shortness of breath
- Fever
- Paleness , fatigue due to anemia
- Weight loss

Interviewing of the patient: complaints (arthralgia)

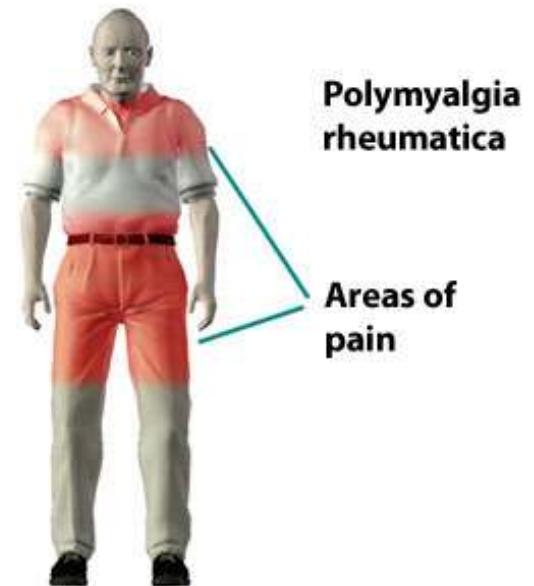
- Arthralgia literally means joint pain
- Arthralgia is a symptom of injury, infection, illnesses (in particular arthritis) or an allergic reaction to medication
- According to Medical Subject Headings (MeSH), the term "arthralgia" should only be used when the condition is non-inflammatory, and the term "arthritis" should be used when the condition is inflammatory



Interviewing of the patient: complaints (myalgia)

- Myalgia, or muscle pain, is a symptom of many diseases and disorders
- The most common causes are the overuse or over-stretching of a muscle or group of muscles
- Myalgia without a traumatic history is often due to viral infections
- Longer-term myalgias may be indicative of a metabolic myopathy, some nutritional deficiencies or chronic fatigue syndrome

Many (poly) painful muscles (myalgia) - where?



Interviewing of the patient: complaints (bone pain)

- Bone pain is pain coming from the bone
- It occurs as a result of a wide range of diseases and/or physical conditions and may severely impair the quality of life for patients who suffer from it
- Bone pain belongs to the class of deep somatic pain, often experienced as a dull pain that cannot be localized accurately by the patient
- Bone pain can have several possible causes ranging from extensive physical stress to serious diseases such as tumor, chronic infection, avascular necrosis, etc.



Interviewing of the patient: complaints (joint stiffness)

- Joint stiffness may be either the symptom of pain on moving a joint, the symptom of loss of range of motion or the physical sign of reduced range of motion after a period of rest
- Pain on movement is commonly caused by osteoarthritis, often in quite minor degrees, and other forms of arthritis, or overuse and rarely by more complex causes of pain such as infection or neoplasm
- "Morning stiffness" pain which eases up after the joint has been used, is characteristic of rheumatoid arthritis
- The patient notices that the joint (or many joints) do not move as far as they used to or need to
- Loss of motion is a feature of more advanced stages of arthritis including osteoarthritis, rheumatoid arthritis and ankylosing spondylitis

Interviewing of the patient: complaints (joint swelling)

- Joint swelling is the buildup of fluid in the soft tissue surrounding the joint
- Joint swelling may occur along with joint pain
- The swelling may cause the joint to appear larger or abnormally shaped
- Joint swelling can cause pain or stiffness
- After an injury, swelling of the joint may mean you have a broken bone or a tear in the muscle tendon or ligament
- Many different types of arthritis may cause swelling, redness, or warmth around the joint
- An infection in the joint can cause swelling, pain, and fever



Gout

Interviewing of the patient: complaints (ankylosis)

- Ankylosis or anchylosis is a stiffness of a joint due to abnormal adhesion and rigidity of the bones of the joint, which may be the result of injury or disease
- The rigidity may be complete or partial and may be due to inflammation of the tendinous or muscular structures outside the joint or of the tissues of the joint itself
- "Ankylosis" is also used as an anatomical term, bones being said to ankylose (or anchylose) when, from being originally distinct, they coalesce, or become so joined together that no motion can take place between them



Rheumatoid knee, ankylosis

Interviewing of the patient: complaints (muscle weakness)

- Muscle weakness or myasthenia is a lack of muscle strength
- The causes are many and can be divided into conditions that have either true or perceived muscle weakness
- True muscle weakness is a primary symptom of a variety of skeletal muscle diseases, including muscular dystrophy and inflammatory myopathy.
- It occurs in neuromuscular junction disorders, such as myasthenia gravis
- Muscle weakness can also be caused by low levels of potassium and other electrolytes within muscle cells



A child with spinal muscular atrophy type

Interviewing of the patient: complaints (limited range of motion)

- Limited range of motion refers to a joint that has a reduction in its ability to move
- The reduced motion may be a mechanical problem with the specific joint or it may be caused by injury or diseases such as osteoarthritis, rheumatoid arthritis, or other types of arthritis
- Pain, swelling, and stiffness associated with arthritis can limit the range of motion of a particular joint and impair function and the ability to perform usual daily activities



Child with crutches

Interviewing of the patient: complaints (bone fractures)

- A bone fracture (sometimes abbreviated FRX or Fx, F_x, or #) is a medical condition in which there is a break in the continuity of the bone
- A bone fracture can be the result of high force impact or stress, or a minimal trauma injury as a result of certain medical conditions that weaken the bones, such as osteoporosis, bone cancer, or osteogenesis imperfecta, where the fracture is then properly termed a pathologic fracture



Primary lymphoma of humerus:
pathologic fracture

Interviewing of the patient: complaints

(a butterfly-shaped rash on the cheeks and bridge of the nose)

- A butterfly rash is a rash that takes the shape of a butterfly
- Known more formally as a 'malar rash', a butterfly rash is most commonly associated with the autoimmune disease lupus, though it can also be present in other conditions and particularly other autoimmune conditions
- Identifying a butterfly rash is an important way then to diagnose cases of lupus, and at the same time it is useful to understand how to treat it and how you can manage it



Interviewing of the patient: complaints (sensitivity to sunlight)

- Photosensitivity, sometimes referred to as a sun allergy, is an immune system reaction that is triggered by sunlight
- Photosensitivity reactions include solar urticaria, chemical photosensitization, and polymorphous light eruption and are usually characterized by an itchy eruption on patches of sun-exposed skin
- People may inherit a tendency to develop these reactions
- Certain diseases, such as systemic lupus erythematosus and some porphyrias, also may cause more serious skin reactions to sunlight



Red skin rash

Interviewing of the patient: complaints (hair loss)

- Hair loss (alopecia, baldness) is a loss of hair from the head or body
- Baldness can refer to general hair loss or male pattern hair loss
- Some types of hair loss can be caused by alopecia areata, an autoimmune disorder
- The extreme forms of alopecia areata are alopecia totalis, which involves the loss of all head hair, and alopecia universalis, which involves the loss of all hair from the head and the body
- Hair loss and hypotrichosis can have many causes, including fungal infection, traumatic damage, as a result of radiotherapy or chemotherapy, and as a result of nutritional deficiencies such as iron deficiency

Interviewing of the patient: complaints (malaise)

- Malaise is a feeling of general discomfort or uneasiness, of being "out of sorts", often the first indication of an infection or other disease
- Malaise is a non-specific symptom and can present in the slightest ailment, such as an emotion (causing fainting, a vasovagal response) or hunger (light hypoglycemia), to the most serious conditions (cancer, stroke, heart attack, internal bleeding, etc.)
- Malaise expresses a patient's uneasiness that "something is not right" that may need a medical examination to determine the significance



Interviewing of the patient: complaints (cold and numb fingers or toes)

- Cold and numb fingers or toes (Raynaud's syndrome or disease), is a disorder of blood circulation in the fingers and toes (and less commonly of the ears and nose)
- Exposure to cold abnormally reduces blood circulation causing the skin to become pale, waxy-white or purple.
- The disorder is sometimes called "white finger", "wax finger" or "dead finger"
- It is most commonly associated with "hand-arm vibration syndrome" but it is also involved in other occupational and autoimmune diseases



Interviewing of the patient: complaints (swollen fingers or hands)

- Swollen fingers or hands is a sign of fluid buildup or inflammation of the tissues or joints of the hand
 - Hand swelling, which is also called hand edema, can also result from serious infections, trauma, and other abnormal processes.
 - Chronic hand swelling, or swelling that builds up over time, often indicates an inflammatory process, such as arthritis
 - Hand swelling can also be caused by orthopedic conditions, such as a bone fracture or a cast that is too tight
- warmth



Interviewing of the patient: complaints (rash)

- A rash is a change of the skin which affects its color, appearance, or texture
- A rash may be localized in one part of the body, or affect all the skin
- Rashes may cause the skin to change color, itch, become warm, bumpy, chapped, dry, cracked or blistered, swell, and may be painful
- Causes of rashes: allergies, for example to food, dyes, medicines, insect stings, metals such as zinc or nickel; reaction to vaccination; skin diseases such as eczema or acne, exposure to sun (sunburn) or heat; friction due to chafing of the skin; irritation such as caused by abrasives impregnated in clothing rubbing the skin; secondary syphilis; poor personal hygiene; autoimmune disorders such as psoriasis; Lyme disease, etc.

Interviewing of the patient: complaints (shortness of breath)

- Most cases of shortness of breath are due to heart or lung conditions
- Other problems: anemia, broken ribs, generalized anxiety disorder , myasthenia gravis, etc.



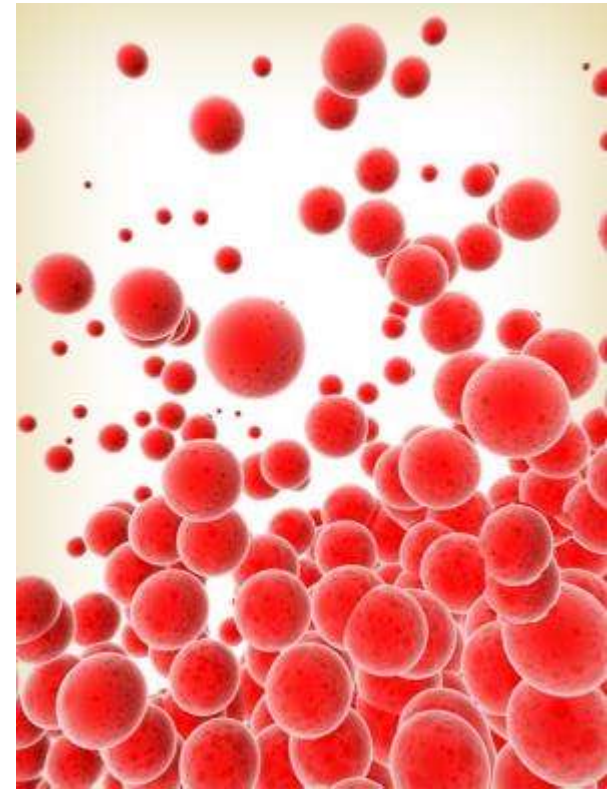
Interviewing of the patient: complaints (fever)

- Fever (pyrexia, febrile response), is defined as having a temperature above the normal range due to an increase in the body's temperature set-point
- A fever can be caused by many medical conditions ranging from the not serious to potentially serious (viral, bacterial, and parasitic infections , autoimmune connective tissue diseases, etc.)



Interviewing of the patient: complaints (anemia)

- Anemia is usually defined as a decrease in the amount of red blood cells (RBCs) or hemoglobin in the blood
- There are three main types of anemia, that due to blood loss, that due to decreased red blood cell production, and that due to increased red blood cell breakdown (hemolysis)
- The main cause of blood loss is bleeding due to trauma, gastrointestinal disorders (ulcer, cancer)
- Causes of decreased production include autoimmune connective tissue diseases, thalassemia, marrow invasion by leukemia, lymphoma, metastatic tumor, etc.



Interviewing of the patient: complaints (weight loss)

- Weight loss refers to a reduction of the total body mass, due to a mean loss of fluid, body fat or adipose tissue and/or lean mass, namely bone mineral deposits, muscle, tendon, and other connective tissue
- Weight loss can either occur unintentionally due to malnourishment or an underlying disease or arise from a conscious effort to improve an actual or perceived overweight or obese state
- "Unexplained" weight loss that is not caused by reduction in calorific intake or exercise is called cachexia and may be a symptom of a serious medical condition
- Serious weight loss may reduce quality of life, impair treatment effectiveness or recovery, worsen disease processes and be a risk factor for high mortality rates

Interviewing of the patient: complaints (deformity)

- A deformity, dysmorphism, or dysmorphic feature is a major difference in the shape of a body part or organ compared to the average shape of that part
- Causes: genetic mutation, damage to the fetus or uterus, complications at birth, a growth or hormone disorder, reconstructive surgery following a severe injury, arthritis and other rheumatoid disorders, chronic paresis, paralysis or muscle imbalance, atc.



Jaccoud's arthropathy

Interviewing of the patient: specific questions for set of complaints

Each of complaints will prompt a series of specific questions that will help arrive at a preliminary single diagnosis, or a group of different diagnoses



Interviewing of the patient: example of specific questions in complaint

- Character
- Location
- Severity
- Timing
- Duration
- Radiation
- Provocation
- Relieving conditions
- When did it first start?
- How often does it occur?
- Is it becoming more frequent with time?
- Were there associated symptoms
- Are the symptoms lasting longer?
- How the symptoms relate to food intake?

Interviewing of the patient: past medical history

In a medical encounter, a past medical history (abbreviated PMH), is the total sum of a patient's health status prior to the presenting problem

The image shows a close-up of a medical form. The section 'Past Medical History' is prominent, with a sub-section for 'Cardiac' conditions. The form includes various checkboxes for medical history, such as 'None', 'Unknown', 'Angina', 'Arrhythmia', 'Cardiomyopathy', 'CHF', 'Congenital', 'Implanted Defib', 'MI', and 'Other'. To the right of the 'Cardiac' section, there are checkboxes for 'None', 'Unknown', 'Abdominal', 'Heart', 'Lung', and 'Neurological'. Below the 'Past Medical History' section, there is a section for 'Chronic Illnesses' with checkboxes for 'Hypertension', 'Diabetes', 'Asthma', 'Chronic Renal', and 'Intestinal'. A black pen is resting on the form, pointing towards the 'Cardiac' section.

Interviewing of the patient: prior or current treatment

- Any constantly used medications
- Previous surgery
- Injections
- Chiropractic
- Exercise/PT
(Physical Therapy)
- ER (Emergency Room)
- Massage therapy



An ancient Greek patient gets medical treatment:
this aryballos (circa 480–470 BCE, now in Paris's Louvre Museum)
probably contained healing oil

Interviewing of the patient: any constantly used medications

- Drugs prescribed for diabetes mellitus, hypertension, cardiac disorders, hormonal disorders, cancer, arthritis, immunopathological processes, psychiatric disorders, etc.



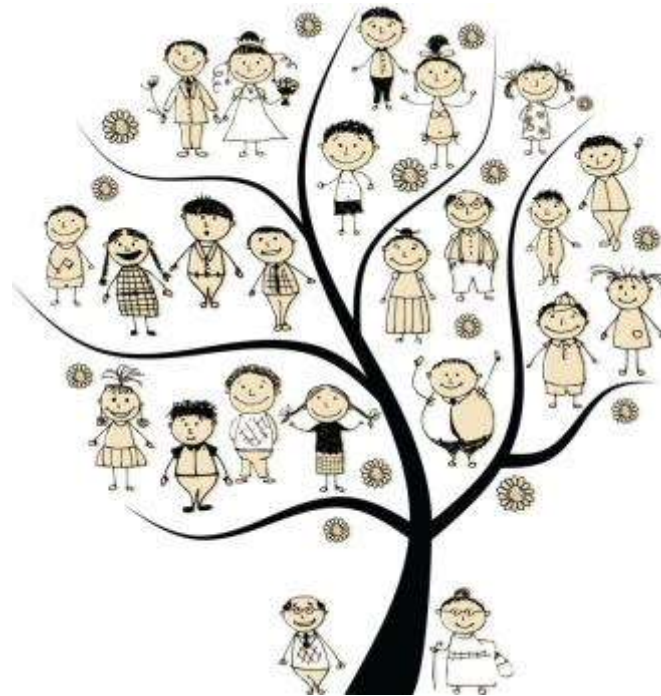
Interviewing of the patient: previous treatment and present status

- Previous Treatment
 - What?
 - Where?
 - When?
 - By whom?
- Present Status
 - Better vs. same vs. worse



Interviewing of the patient: family history and genetic risk

- Certain of the musculoskeletal system and connective tissue diseases may occur in more than one member of a family
- The physician will inquire about the health of the patient's parents, brothers, sisters and children
- A family history of the musculoskeletal system and connective tissue diseases may be relevant to the underlying problem



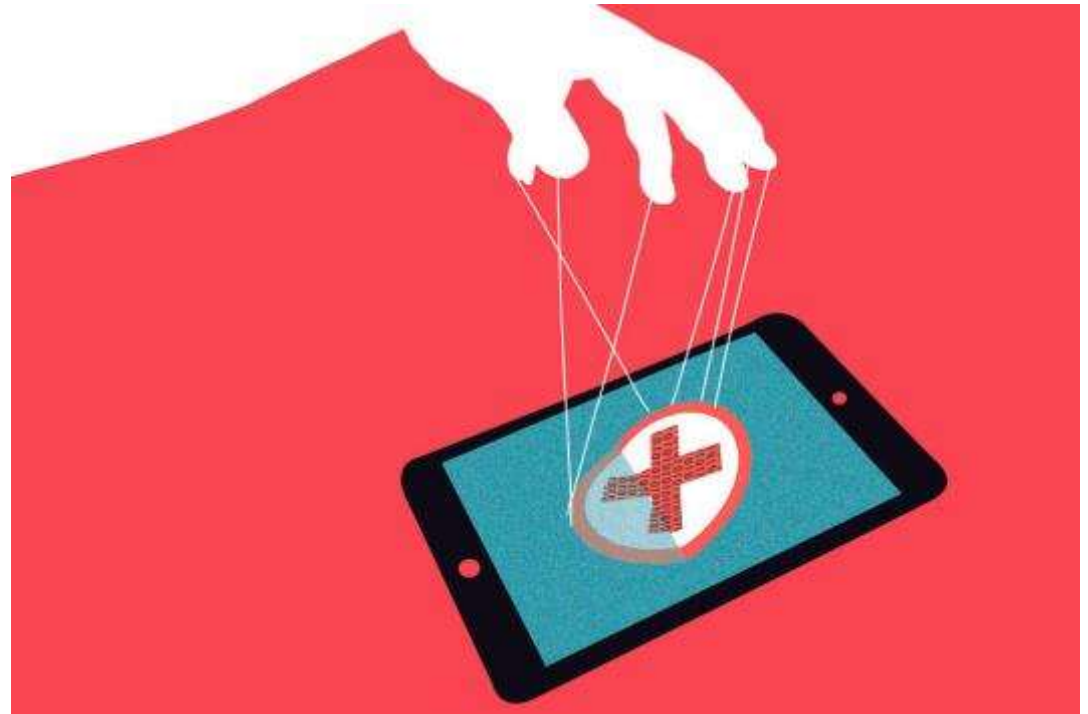
Interviewing of the patient: social history

- High-risk behaviors
 - Alcohol, tobacco, or drug abuse
 - Depression
 - Violence
 - Sedentary lifestyle
 - Previous joint injury while playing a sport
 - Work-related ergonomic risk factors (high task repetition, high force and/or awkward postures)
 - Obesity
 - Age
 - Sex (Fem - rheumatoid arthritis, lupus, Males – gout)
- Signs of any of the above behaviors may warrant referral to a secondary provider



Interviewing of the patient: why take a medical history?

- Up to 90% of conditions can be accurately diagnosed or recognized by conducting a thorough medical history and listening carefully to the patient's response(s)
- It determines the necessary tests and measures you should prioritize for pt's objective examination



Interviewing of the patient: review of systems

- The "laundry list" of symptoms related to various organs of the body
- A series of questions helps seek out information that the patient may have neglected to provide the physician
- Review of systems helps to identify the patient's problem, or exclude different parts of the differential diagnosis



Interviewing of the patient: systemic enquiry

- General: fever, weight loss, loss of appetite, lethargy
- Respiratory and cardiovascular systems: shortness of breath, cough, hemoptysis, wheeze, chest pain
- Gastrointestinal system: nausea and vomiting, hematemesis, dysphagia, heartburn, jaundice, abdominal pain, change in bowel habit, rectal bleeding, tenesmus (sensation of incomplete bowel emptying)
- Genito-urinary system: dysuria (pain on passing urine), frequency, terminal dribbling, urethral discharge
- Gynecological system: pelvic pain, vaginal bleeding, vaginal discharge, LMP
- Neurological system: headaches, dizziness, loss of consciousness, fits, faints, funny turns, numbness, tingling, weakness, problems speaking, change in vision

Interviewing of the patient:

Musculoskeletal System and Connective Tissue Diseases Quality of Life Indexes

- The Musculoskeletal System and Connective Tissue Diseases Quality of Life Indexes are a questionnaires which measures Quality of Life of these type of patients
- Indexes are multidimensional constructs with several dimensions: emotional or psychological well being, physical functioning, social functioning, and symptoms of the disease and treatment
- A single item that identifies perceived change in health is also included, making the Indexes useful in measuring of changes in Musculoskeletal System and Connective Tissue Diseases Quality of Life Indexes over time and treatment

Physical examination of the patient: general inspection

- Whether patient is comfortable at rest
- Are there any gross abnormalities
- Are there any obvious patient' skin changes
- Observe gait, and note any awkwardness in rhythm, weight shifting, or imbalance
- Inspect muscles for hypertrophy and atrophy, and note areas of ecchymoses which point to previous trauma
- Note any bone bowing, angulation, or tumor
- Inspect visceral organs and systems for inflammation and functional deviations
- Are there any obvious medical appliances



Parkinsonian Gait

Physical examination of the patient: the classical "look - feel - move" approach

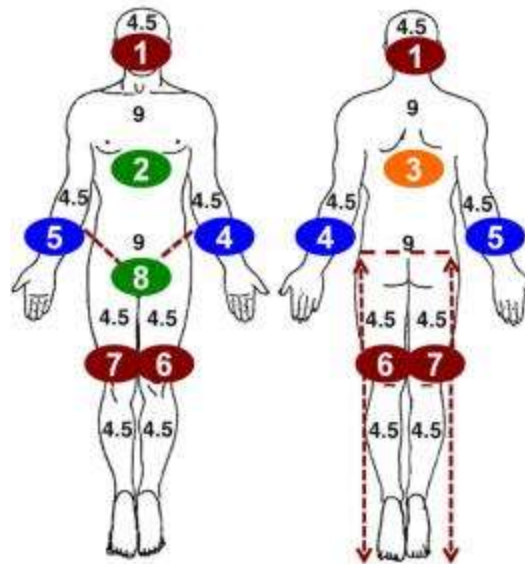
- This approach is the most useful one in localizing the pathology
- This requires differentiating between articular versus extraarticular source
- Every joint should be assessed individually, and the soft tissue, contractile structures around the joint appropriately examined

Joint	Primary movement
Wrist	Flexion / Extension
Elbow	Flexion / Extension
Shoulder	Abduction / External Rotation
Neck	All movement except flexion
Thoracic	Extension
Lumbar	Lateral flexion / Flexion
Hips	Flexion / Internal rotation
Knees	Flexion
Ankle	Plantar flexion
Subtalar	Varus

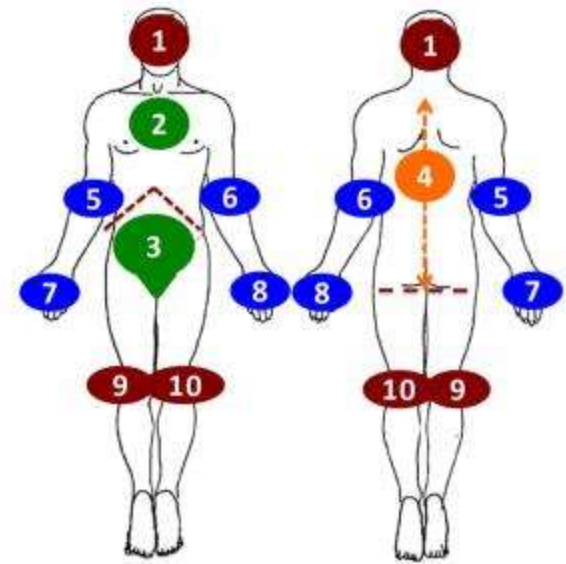
Physical examination of the patient: the classical "look - feel - move" approach: look

- Gait
- Swelling
- Redness in joints or tendons
- Skin changes (examine for psoriasis, Raynaud's phenomenon, ulceration of skin and rashes)
- Wasting of regional muscles
- Deformity or contracture

NIH Assessment uses
Rule of 9s
8 body areas



Vienna Skin Score
10 body areas



Physical examination of the patient: the classical "look - feel - move" approach: feel

- Palpate the margins of each joint
- Synovial thickening is felt as a "soft spongy" texture with the additional presence of fluid identified by fluctuant swelling
- Each joint is palpated in turn and presence or absence of synovial thickening is recorded



Exerts pressure with one thumb and then the other to ballot for increased joint fluid

Physical examination of the patient: the classical "look - feel - move" approach: move

- Active movement: the patient utilizes his own muscles and contractile structures to move a particular joint through its range of movement
- Passive movement: the patient is encouraged to relax and the examiner moves the joint through its accepted range of movement
- Resisted movement: this isolates the cause to a particular tendon or bursa, the joint is made to relax then force is applied by the patient against resistance of the examiner



Physical examination of the patient:

summary of information seen on musculoskeletal examination

- Skin: color change, consistency, sweating or coldness, eruptions, ulcerations
- Heat
- Soft tissue swelling: synovial thickening, periarticular swelling, nodules, effusion
- Wasting (atrophy, dystrophy, spasm, contracture)
- Tenderness to palpation and pain on motion
- Crepitation
- Deformity: abnormal angulation, subluxation
- Limitation of motion
- Stability
- Abnormalities of trunk and spine: scoliosis, kyphosis, limitation of motion
- Flexion (mostly easily documented by measuring lengthening): lateral flexion, rotation
- Ambulation: ability to ambulate with or without aids, gait

Physical examination of the patient: skin changes



Rheumatoid arthritis:
vasculitis with small
infarcts, fingers



The skin rashes of
Churg-Strauss
syndrome



Gout

Physical examination of the patient: soft tissue swelling



The swelling is a
indicator of the degree
of soft-tissue injury



An asymptomatic
swelling on the dorsum
of left hand



The swollen ankles

Physical examination of the patient: soft tissue swelling



Muscle
Atrophy



Myotonic
dystrophy

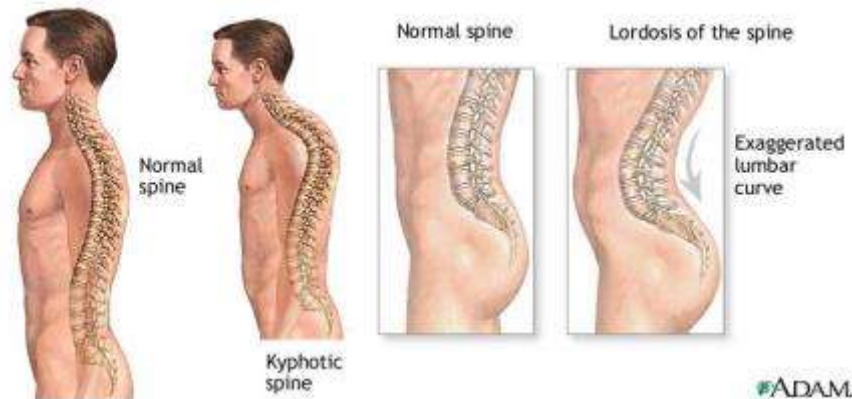


Muscle
spasm

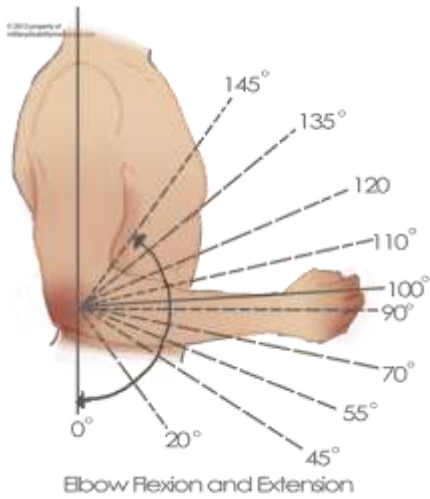


Severe dorsal
contracture

Physical examination of the patient: deformity



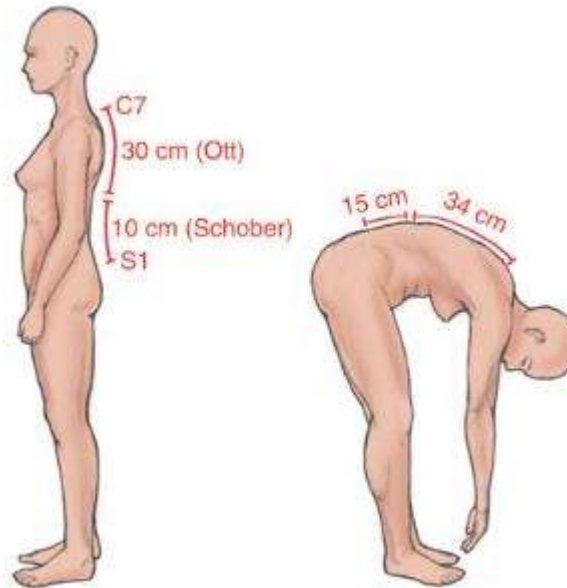
Physical examination of the patient: limitation of motion



Elbow flexion and
extension



Fingers
motion



Schober's
and Ott's
signs



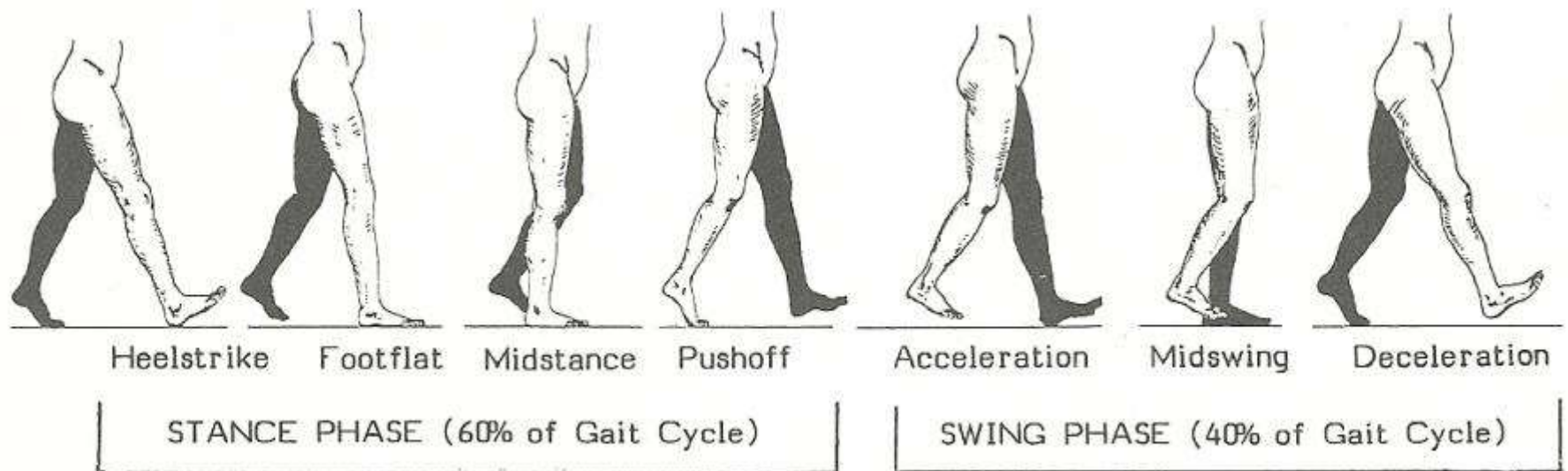
Limited
spine
motion

http://images.rheumatology.org/image_dir/album75694/md_99-07-0013.tif.jpg

<http://www.clevelandclinicmeded.com/medicalpubs/diseasemanagement/rheumatology/ankylosing-spondylitis/images/figure-1.jpg>

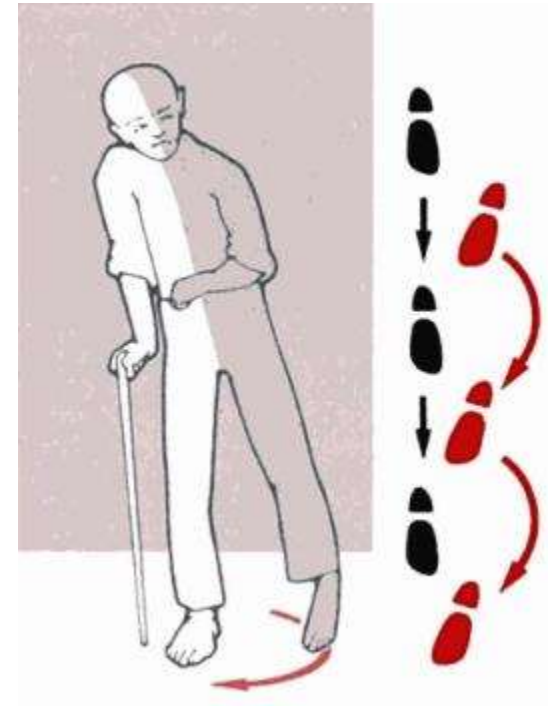
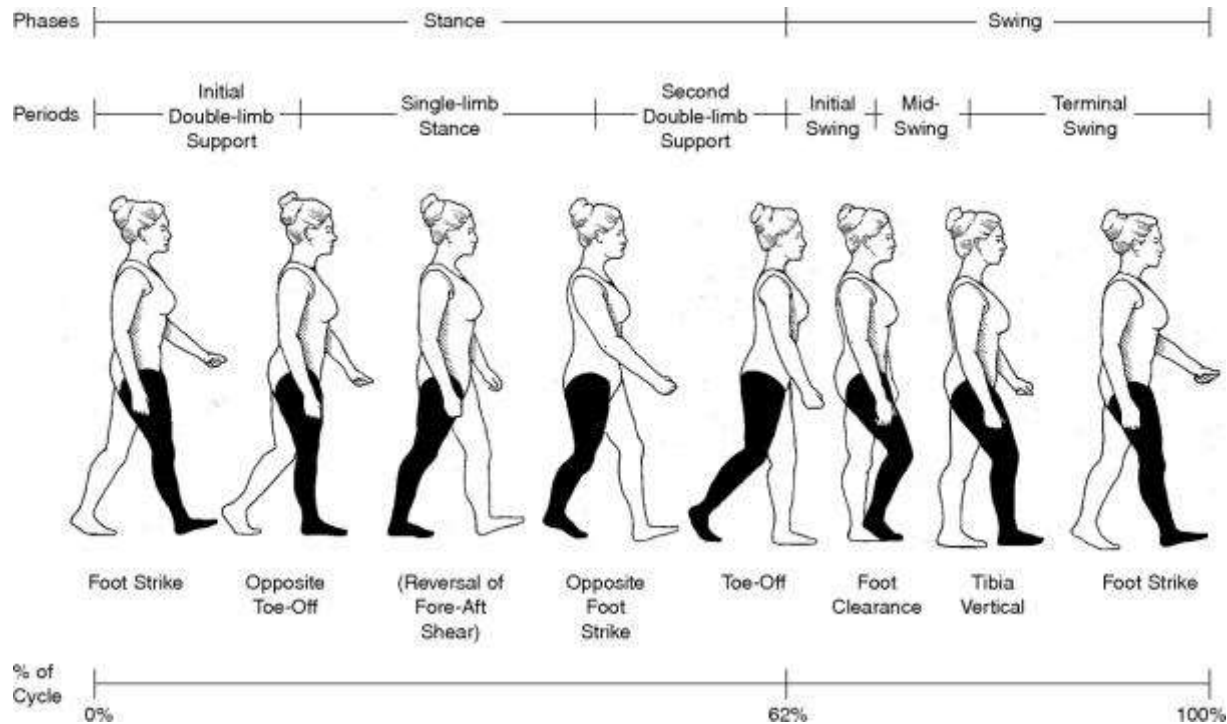
<http://harms-spinesurgery.com/src/plugin.php?m=harms.2690.preview&t=file&nocache=1&ism=off&lang=ru> <http://militarydisabilitymadeeasy.com/images/elbow/elbow%20motion%204.png>

Physical examination of the patient: normal walking



- Watch the patient walk: there should be symmetry and smoothness of movement and arm swing with no pelvic tilt and normal stride length
- The patient should be able to start, stop and turn quickly

Physical examination of the patient: examples of gait deviations



Evaluation of the Elderly Patient With an Abnormal Gait

Gait of a hemiplegic patient

Physical examination of the patient:

Raynaud phenomenon

- Raynaud phenomenon manifests as recurrent vasospasm of the fingers and toes and usually occurs in response to stress or cold exposure
- Secondary Raynaud phenomenon should be distinguished from primary Raynaud phenomenon (Raynaud disease)
- Diagnostic criteria for primary Raynaud phenomenon:
 - Attacks triggered by exposure to cold and/or stress
 - Symmetric bilateral involvement
 - Absence of necrosis
 - Absence of a detectable underlying cause
 - Normal capillaroscopy findings
 - Normal laboratory findings for inflammation
 - Absence of antinuclear factors



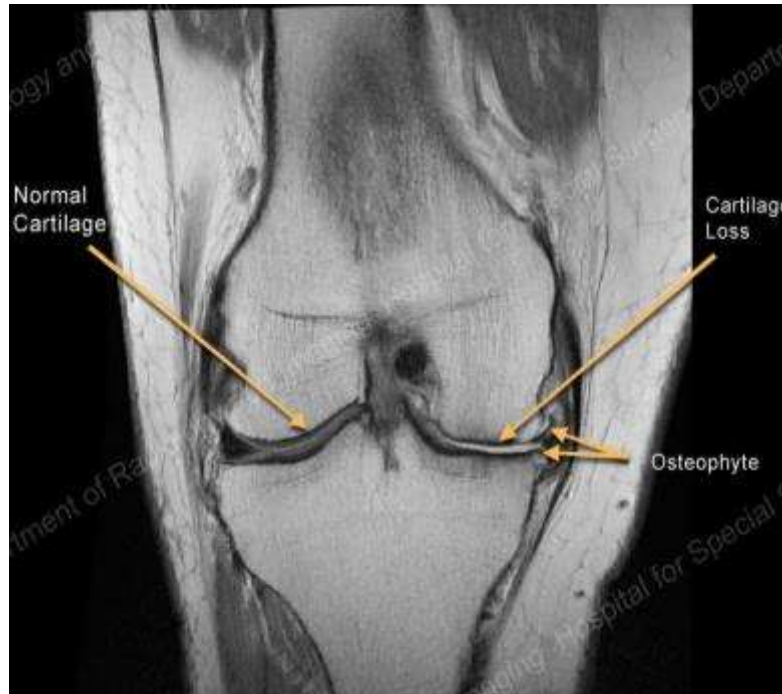
Instrumental methods: imaging studies

- Imaging studies are often unnecessary. Plain x-rays in particular reveal mainly bony abnormalities, and most joint disorders do not affect bone primarily. However, imaging may help in the initial evaluation of relatively localized, unexplained, persistent or severe joint and particularly spine abnormalities; it may reveal primary or metastatic tumors, osteomyelitis, bone infarctions, periarticular calcifications (as in calcific tendinitis), or other changes in deep structures that may escape physical examination. If chronic RA, gout, or osteoarthritis is suspected, erosions, cysts, and joint space narrowing with osteophytes may be visible. In pseudogout, Ca pyrophosphate deposition may be visible in intra-articular cartilage.
- For musculoskeletal imaging, plain x-rays may be obtained first, but they are often less sensitive, particularly during early disease, than MRI, CT, or ultrasonography. MRI is the most accurate study for fractures not visible on plain x-rays, particularly in the hip and pelvis, and for soft tissues and internal derangements of the knee. CT is useful if MRI is contraindicated or unavailable. Ultrasonography, arthrography, and bone scanning may help in certain conditions, as can biopsy of bone, synovium, or other tissues.

Instrumental methods: magnetic resonance imaging (MRI)



A sharply margined bone lesion in a juxta-articular location typically seen in inflammatory arthritis



A sharply margined bone lesion in a juxta-articular location typically seen in inflammatory arthritis



Chronic Tendinitis

Instrumental methods: computed tomography (CT)



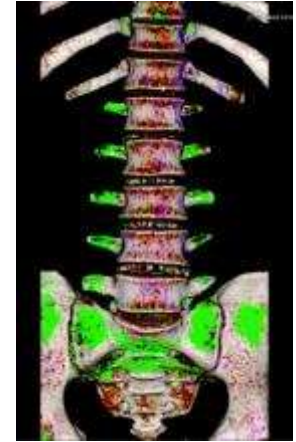
Three-dimensional volume-rendered image showing crystal deposition (green) at sites throughout the feet



Interstitial lung diseases in collagen vascular disease

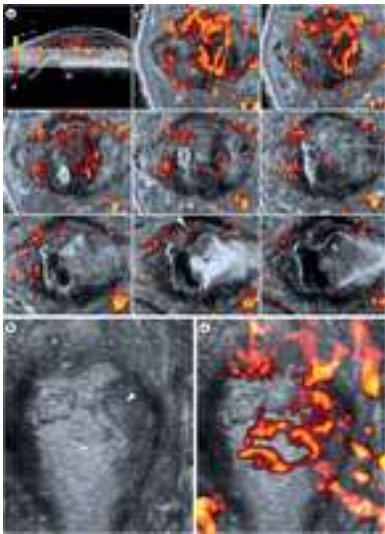


spinal fracture in diffuse idiopathic skeletal hyperostosis

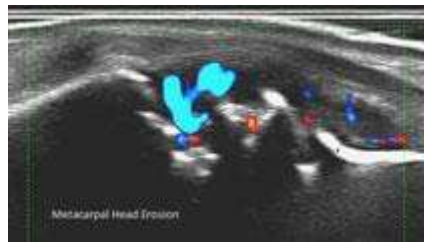


Dual-energy CT in evaluation of axial gout

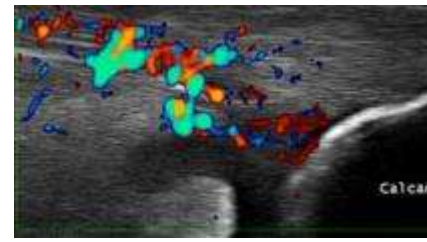
Instrumental methods: ultrasonography



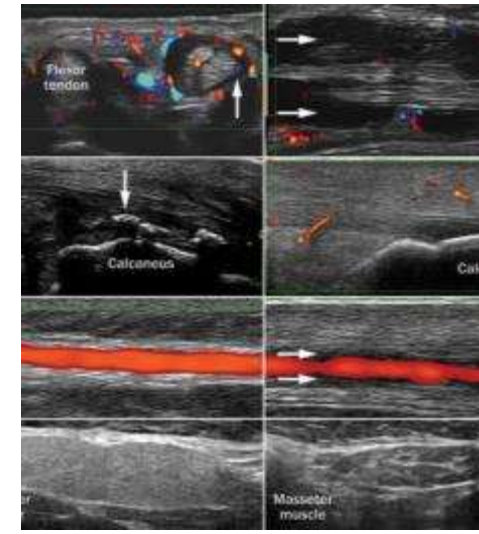
**Representative
images of
rheumatoid
arthritis**



**Active synovitis
overlying a large
metacarpal head
erosion**



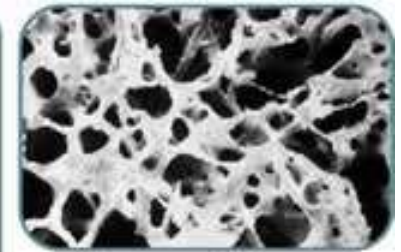
**Achilles tendinopathy
and retrocalcaneal
bursitis**



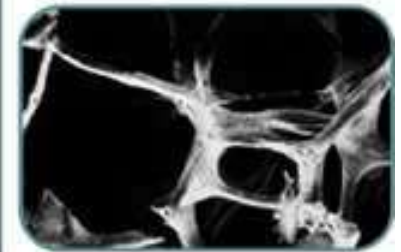
**Inflammatory
rheumatic disease**

Instrumental methods: bone densitometry

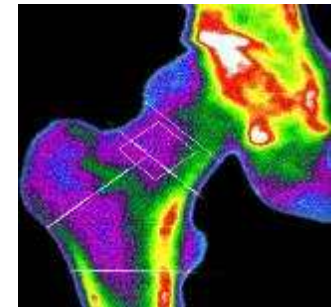
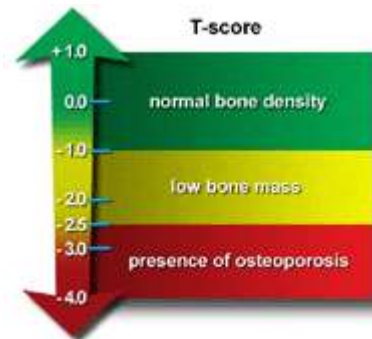
- Bone density is a medical term normally referring to the amount of mineral matter per square centimeter of bones
- Bone density is used as an indirect indicator of osteoporosis and fracture risk
- Bone density is measured by a densitometry, performed in the radiology departments of hospitals
- Measurements are most commonly made over the lumbar spine and over the upper part of the hip
- The forearm may be scanned if the hip and lumbar spine are not accessible



Normal Bone

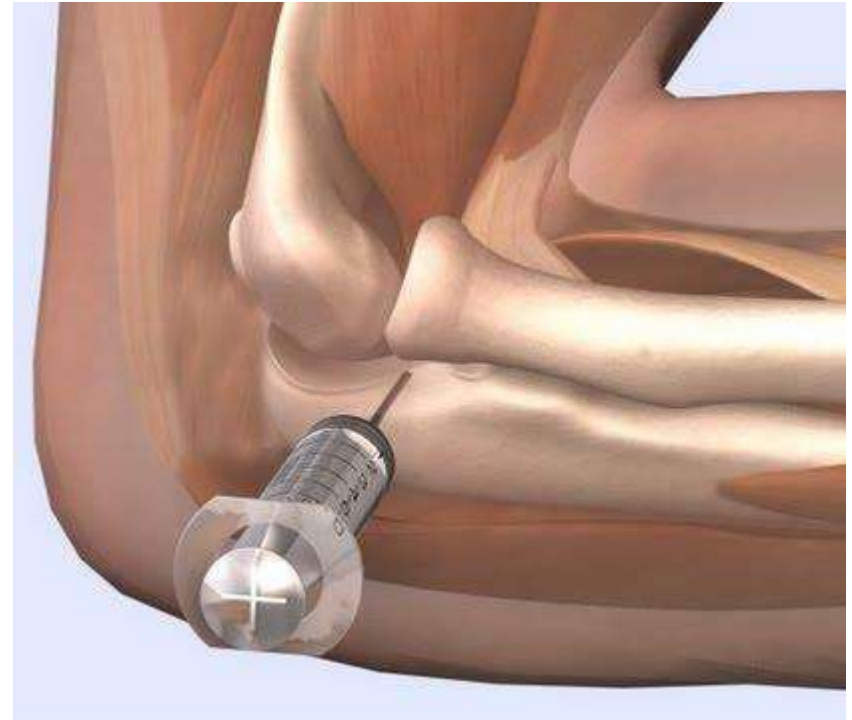


Osteoporotic Bone



Instrumental methods: arthrocentesis

- Arthrocentesis is the process of puncturing the joint with a needle to withdraw fluid
- If there is an effusion and arthrocentesis is done correctly, fluid can typically be withdrawn
- Examination of synovial fluid is the most accurate way to exclude infection, diagnose crystal-induced arthritis, and otherwise determine the cause of joint effusions
- This procedure is indicated for all patients with acute or unexplained monarticular joint effusions and for patients with unexplained polyarticular effusions



Arthrocentesis method: elbow

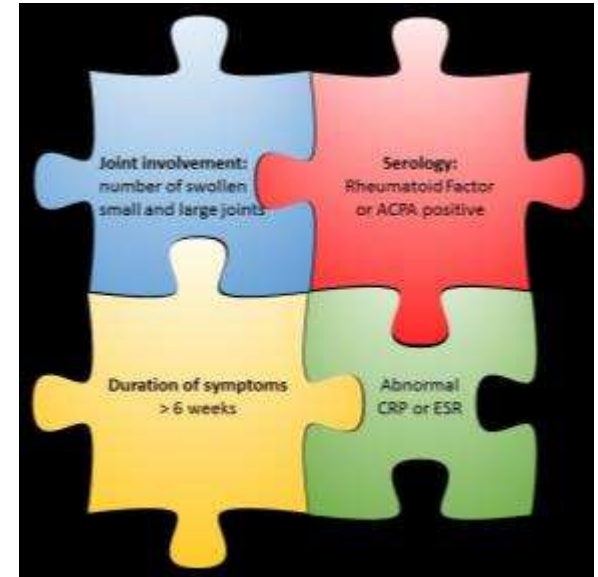
Instrumental methods: synovial fluid examination

	WBC/mm ³	Color	Viscosity
Normal	< 150	Colorless/Straw	High
Noninflammatory	< 3,000	Straw/Yellow	High
Inflammatory	> 3,000	Yellow	Low
Septic (purulent)	> 50,000	Pus/Mixed	Mixed
Hemorrhagic	Similar to blood	Red	Low

- At the bedside, gross characteristics of the fluid are assessed, such as its color and clarity (noninflammatory, inflammatory, infectious, hemorrhagic)
- Laboratory tests commonly done on joint fluid include cell count, leukocyte differential, Gram stain and culture (if infection is a concern), and wet drop examination for cells and crystals
- Microscopic examination (definitive diagnosis of gout, pseudogout, and other crystal-induced arthritides)

laboratory methods: Blood Tests

- Antinuclear antibodies (ANA) and anti-double-stranded DNA antibodies in SLE
- Rheumatoid factor and anti-cyclic citrullinated peptide (anti-CCP) antibodies in RA
- HLA-B27 in spondyloarthropathy (e.g., with symptoms of inflammatory back pain and normal x-rays)
- Antineutrophil cytoplasmic antibodies (ANCA) in certain vasculitides (sometimes useful when systemic involvement is suspected)
- LE cells
- CBC (complete blood count)
- WBC count (not highly specific or sensitive)
- ESR (not highly specific or sensitive)
- C-reactive protein (not highly specific or sensitive)
- Creatinine

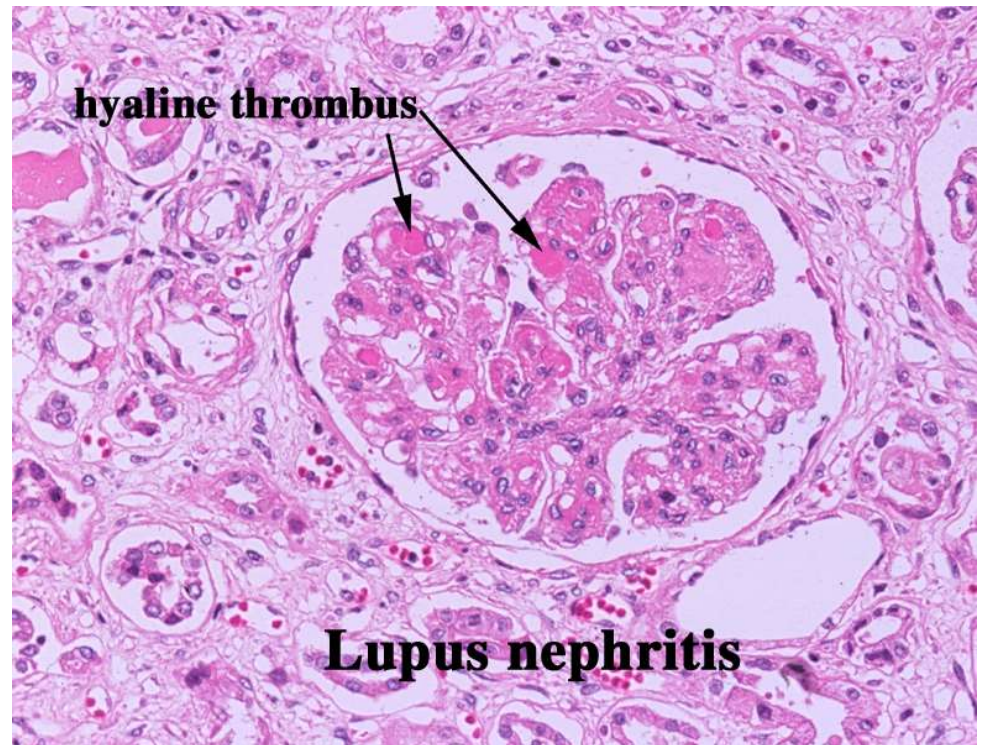


The jigsaw puzzle of rheumatoid arthritis classification

laboratory methods: urinalysis

Tests on glomerulonephritis associated with connective tissue disease:

- Red blood cells and red cell casts in urine
- White blood cells, a common indicator of infection or inflammation
- Increased protein, which may indicate nephron damage



Lecture 9

Approach to the patient with
affection and disease of the blood

Plan of the lecture



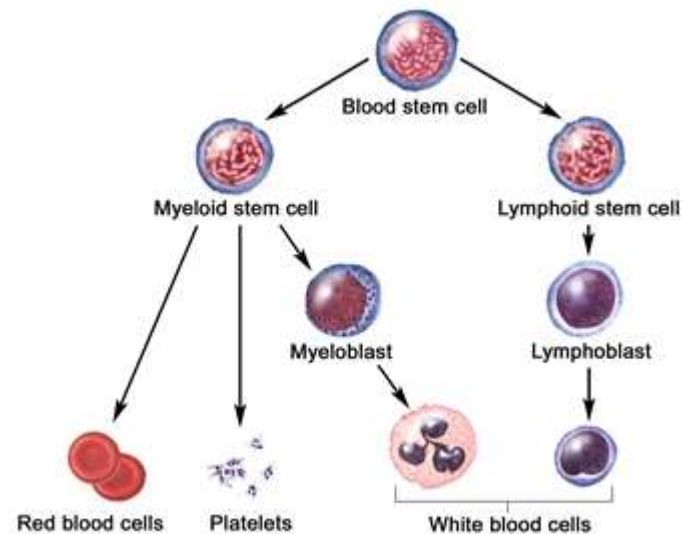
Approach to the Patient with Affection and Disease of the Blood

- Blood disorders definition
- Interviewing of the patient
- Physical examination of the patient
- Instrumental methods
- laboratory methods

Blood disorders definition

Blood disorders can affect any of the three main components of blood

- Red blood cells, which carry oxygen to the body's tissues
- White blood cells, which fight infections
- Platelets, which help blood to clot
- Blood disorders can also affect the liquid portion of blood (plasma)
- Treatments and prognosis for blood diseases vary, depending on the blood condition and its severity



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Interviewing of the patient: four overlapping processes

1. *engaging* (connecting with patients and establishing a good working relationship)
2. *focusing* (agreeing on the target of motivational enhancement and directing the conversation toward it)
3. *evoking* (drawing out the patients' own motivations for changing the target behavior)
4. *planning* (developing commitment to change and formulating a specific plan of action)



Interviewing of the patient: Good questions to get started on the core interview



Communication skills:

- Active listening
- Empathy
- Building rapport
- Open-ended questions
- Leading questions
- Silence
- “Why” questions
- Nonverbal communication cues

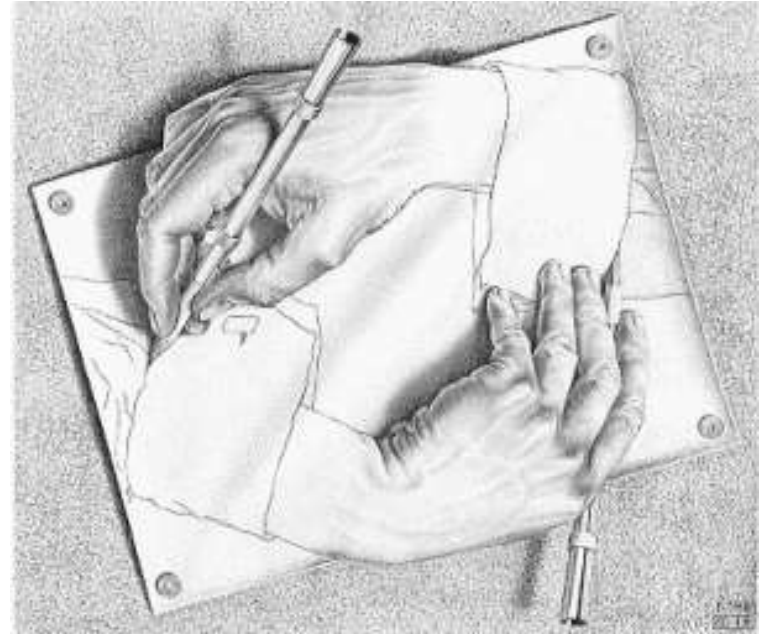
Interviewing of the patient: Good questions to get started on the core interview

- What is your chief complaint?
- Tell me why you're here today
- Tell me about your injury
- What can I do to help you?
- Explain to me your understanding of your injury

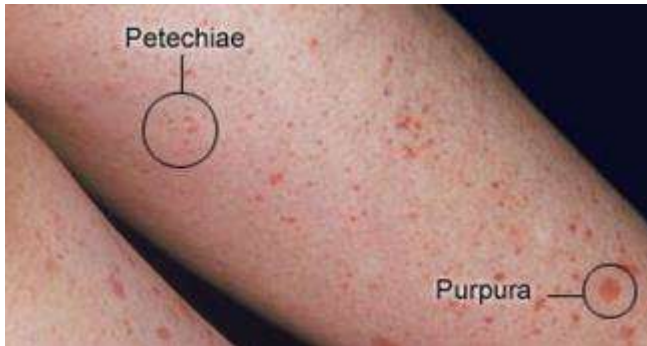


Interviewing of the patient: Patient profile

- Age
- Sex
- Race/Ethnicity (for example, sickle cell disease occurs mainly in blacks)
- Handedness
- Ht-Wt-BMI-Body type
- Primary language
- Barriers to learning
- Learning preference
- Unique rehabilitation goals



Interviewing of the patient: complaints



- Fatigue
- Weakness
- Shortness of breath
- Recurrent fever and infections
- Abnormal bleeding and bruising
- Petechiae
- Redness
- Purpura
- Blood blisters
- Bone pain



- Pallor
- Red complexion (plethora)
- Thrombosis (inappropriate excessive blood clotting)
- Swelling
- Warmth of the legs
- Swollen lymph nodes
- Pica
- Abdomen enlargement because of liver and spleen enlargement

Interviewing of the patient: complaints (fatigue)

- Fatigue (exhaustion, tiredness, languidness, languor, lassitude, listlessness) is a subjective feeling of tiredness which is distinct from weakness, and has a gradual onset
- Chronic blood loss frequently results in chronic fatigue lasting at least six consecutive months and may be either persistent or relapsing
- Some major categories of blood diseases that feature fatigue include such as anemia, hemochromatosis, leukemia (lymphoma)



Interviewing of the patient: complaints (weakness)

- Weakness is the feeling of body fatigue (tiredness)
- A person experiencing weakness may not be able to move that part of their body properly or they may experience tremors (uncontrollable movement or twitches) in the area of weakness



Interviewing of the patient: complaints (shortness of breath)

- Shortness of breath, dyspnea, dyspnoea, or breathlessness is the feeling or feelings associated with impaired breathing
- Anaemia caused by low hemoglobin levels is often a cause of shortness of breath



Interviewing of the patient: complaints (recurrent fever and infections)

- This syndrome includes recurrent episodes of fever with stomatitis and pharyngitis
- Fever can occur during the day or night, although drenching night sweats are often a manifestation of malignancy and, if persistent, should prompt the clinician to consider neoplastic disease, i.e. blood cancers, like leukemia and lymphoma
- Physicians should counsel their patients with suspected persistent fever to keep a temperature diary, taking their temperature at periods throughout the day and night in order to assess any underlying pyrexial pattern



Interviewing of the patient: complaints (abnormal bleeding and bruising)

- Spontaneous bleeding may occur in almost any part of the body, but it is most common in the nose and mouth and the digestive tract
- People with hemophilia often bleed into their joints or muscles
- Several symptoms may suggest that a person has a bleeding disorder:
 - Unexplained nosebleeds (epistaxis)
 - Excessive or prolonged menstrual blood flow (menorrhagia)
 - Prolonged bleeding after minor cuts, blood drawing, minor surgical or dental procedures, or tooth brushing or flossing
 - Unexplained skin marks, including tiny red or purple dots (petechiae), red or purple patches (purpura), bruises (ecchymoses), or small blood vessels that are widened and therefore visible in the skin or mucous membranes (telangiectasias)
 - Sometimes a laboratory test done for some other reason shows the person has a susceptibility to bleeding

Interviewing of the patient: complaints (abnormal bleeding and bruising)



Purpura bruising



Hemophilia

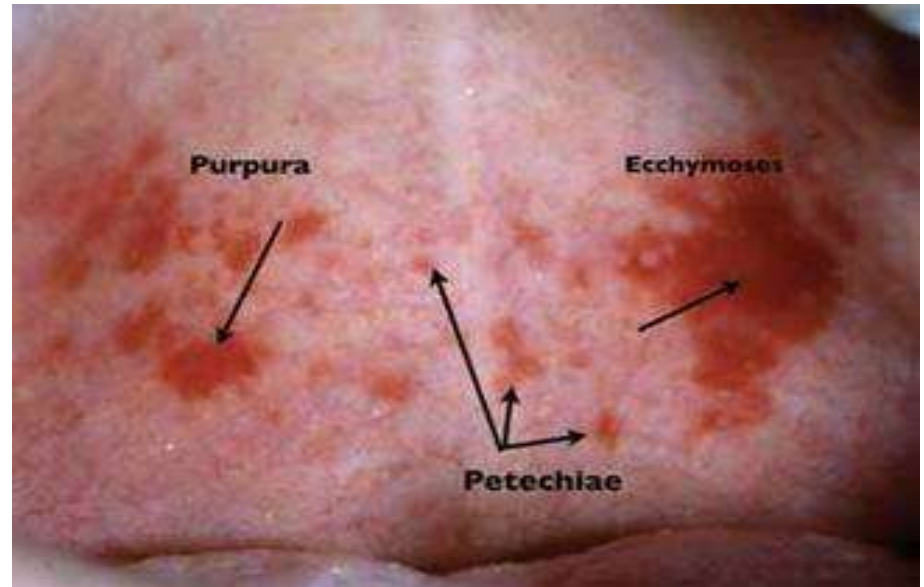


**Anticoagulants warfarin:
side effects**

- An abnormality in the factors can lead to excessive bleeding or bruising:
- Platelet disorders, including too few platelets (thrombocytopenia), too many platelets, and defective platelet function
- Decreased activity of blood clotting factors (for example, due to hemophilia, liver disorders, or vitamin K deficiency or to the use of certain drugs)
- Defects in blood vessels (for example, due to damage)

Interviewing of the patient: complaints (petechiae)

- A petechiae are a small (1–2 mm) red or purple spots on the skin, caused by a minor bleed (from broken capillary blood vessels)
- Petechiae refers to one of the three descriptive types of bleeding into the skin differentiated by size, the other two being purpura and ecchymosis
- Some major categories of blood diseases that feature petechiae include such as thrombocytopenia, clotting factor deficiencies, leukemia



Interviewing of the patient: complaints (purpura)

- Purpura are red or purple discolorations on the skin that do not blanch on applying pressure
- Purpura measure 0.3–1 cm (3–10 mm), whereas petechiae measure less than 3 mm, and ecchymoses greater than 1 cm
- Some major categories of blood diseases that feature purpura include such as platelet disorders, and coagulation disorders (disseminated intravascular coagulation, scurvy (vitamin C deficiency))



Interviewing of the patient: complaints (redness)

- Redness of the skin or erythema, is caused by hyperemia of superficial capillaries
- Redness disappears on finger pressure (blanching), while purpura or bleeding in the skin and pigmentation do not
- There is no temperature elevation, unless it is associated with the dilation of arteries in the deeper layer of the skin



Interviewing of the patient: complaints (blood blisters)

- A blood blister is a type of blister that forms when subdermal tissues and blood vessels are damaged without piercing the skin
- It consists of a pool of lymph, blood and other body fluids trapped beneath the skin
- Some blood blisters can be extremely painful due to bruising where the blister occurred



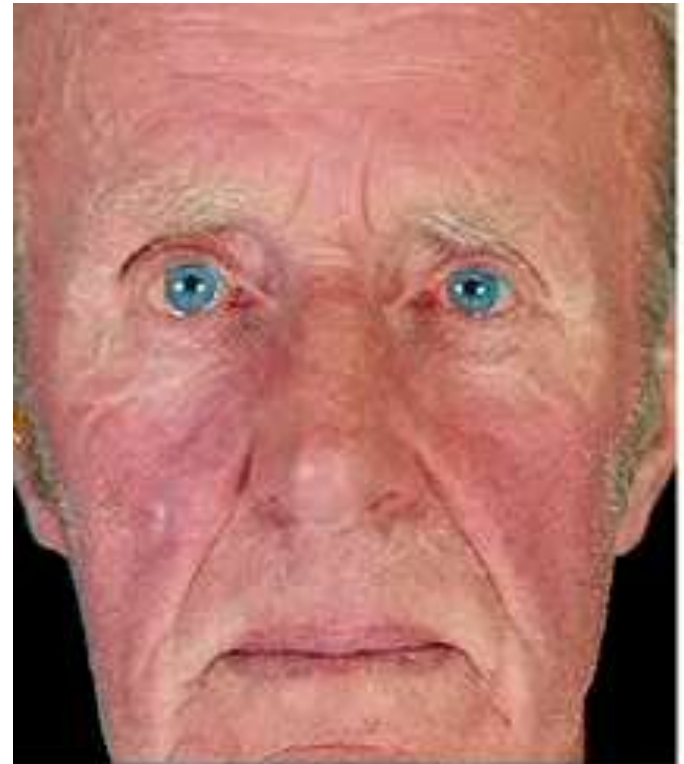
Interviewing of the patient: complaints (pallor)

- Pallor is a pale color of the skin that can be caused by illness, emotional shock or stress, stimulant use, or anemia, and is the result of a reduced amount of oxyhaemoglobin and is visible in skin or mucous membrane
- Pallor is more evident on the face and palms



Interviewing of the patient: complaints (red complexion (plethora))

- Patients with a high red blood cell mass (polycythemia vera) have plethora or a red complexion
- If the polycythemia is secondary to hypoxia, patients can also appear cyanotic
- Increased red blood cell mass increases blood viscosity and decreases tissue perfusion
- With impaired circulation to the central nervous system, patients may present with headaches, lethargy, and confusion or more serious presentations, such as stroke



Interviewing of the patient: complaints (thrombosis (inappropriate excessive blood clotting))

- Thrombosis is the formation of a blood clot inside a blood vessel, obstructing the flow of blood through the circulatory system
- A clot that breaks free and begins to travel around the body is known as an embolus
- The main causes of thrombosis are given in Virchow's triad which lists hypercoagulability, endothelial cell injury, and disturbed blood flow
- Hypercoagulability or thrombophilia, is caused by, for example, genetic deficiencies or autoimmune disorders



Interviewing of the patient: complaints (swelling)

- Swelling is an increase in the size or a change in the shape of an area of the body
- Swelling can be caused by collection of body fluid, tissue growth, or abnormal movement or position of tissue
- Swelling in blood diseases often is the result of an inappropriate excessive blood clotting



Interviewing of the patient: complaints (warmth of the leg)

- Deep venous thrombosis (DVT) refers to a blood clot embedded in one of the major deep veins of the lower legs, thighs, or pelvis
- A clot blocks blood circulation through these veins, which carry blood from the lower body back to the heart
- The blockage can cause acute pain, swelling, or warmth in the affected leg



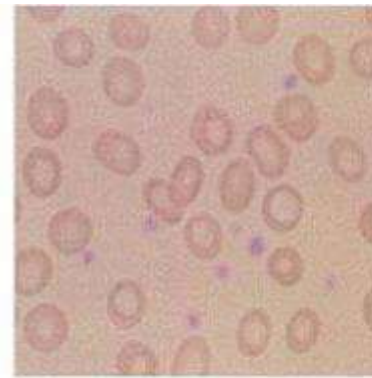
Interviewing of the patient: complaints (swollen lymph nodes)

- Lymph nodes in only one body area may be swollen, or nodes in two or more body areas can be swollen
- Probably less than 1% of people with swollen lymph nodes have cancer, including leukemia
- Swollen lymph nodes in leukemia patients typically are found in the throat, armpits, or groin

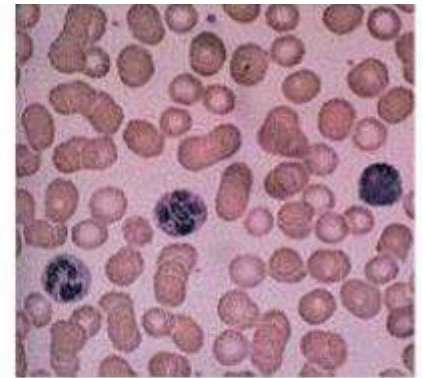


Interviewing of the patient: complaints (pica)

- Pica is characterized by an appetite for substances that are largely non-nutritive, such as paper, clay, metal, chalk, soil, glass, or sand
- The scant research that has been done on the causes of pica suggests that the disorder is a specific appetite caused by mineral deficiency in many cases, such as iron deficiency anemia

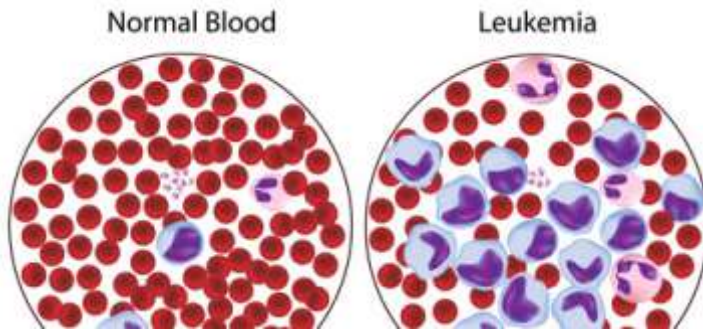


anemia

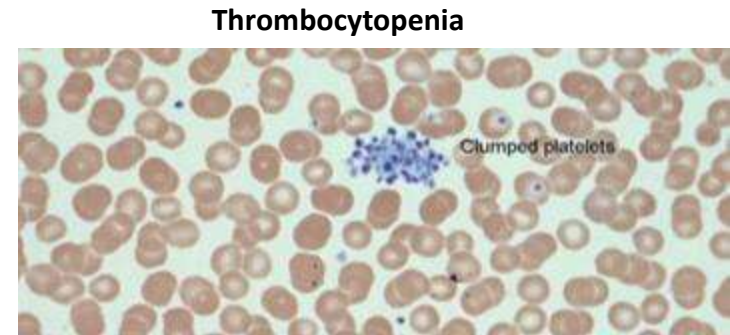


normal blood

Interviewing of the patient: symptoms in complaints



- Decreased red blood cells, hemoglobin, iron deficiency: fatigue, weakness, shortness of breath, pallor, pica
- Decreased white blood cells or immune system proteins: recurrent fever and infections
- Decreased platelets or blood clotting factors: abnormal bleeding, bruising, petechiae



- Increased red blood cells: headache and a red complexion (plethora)
- Increased white blood cells or immune system proteins: increased blood viscosity (thickening of the blood)
- Increased platelets or blood clotting factors: redness, thrombosis (inappropriate excessive blood clotting)

Interviewing of the patient: specific questions for set of complaints

Each of complaints will prompt a series of specific questions that will help arrive at a preliminary single diagnosis, or a group of different diagnoses



Interviewing of the patient: example of specific questions in complaint

- Character
- Location
- Severity
- Timing
- Duration
- Radiation
- Provocation
- Relieving conditions
- When did it first start?
- How often does it occur?
- Is it becoming more frequent with time?
- Were there associated symptoms
- Are the symptoms lasting longer?
- How the symptoms relate to food intake?

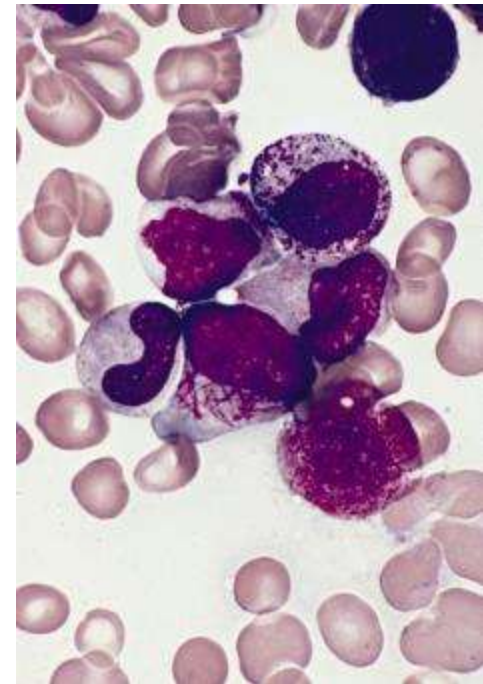
Interviewing of the patient: past medical history

In a medical encounter, a past medical history (abbreviated PMH), is the total sum of a patient's health status prior to the presenting problem

The image shows a close-up of a medical form. The section 'Past Medical History' is highlighted. It includes a 'Cardiac' subsection with options: ☐ None, ☐ Unknown, ☐ Angina, ☐ Arrhythmia, ☐ Cardiomyopathy, ☐ CHF, ☐ Congenital, ☐ Implanted Defib, and ☐ Other. To the right, there are more options: ☐ None, ☐ Unknown, ☐ Abdominal, ☐ Heart, and ☐ Lung. Below the 'Past Medical History' section, the 'Chronic Illnesses' section is partially visible, with options for 'sis/Renal' and 'intestinal'. A black pen is resting on the form.

Interviewing of the patient: prior or current treatment

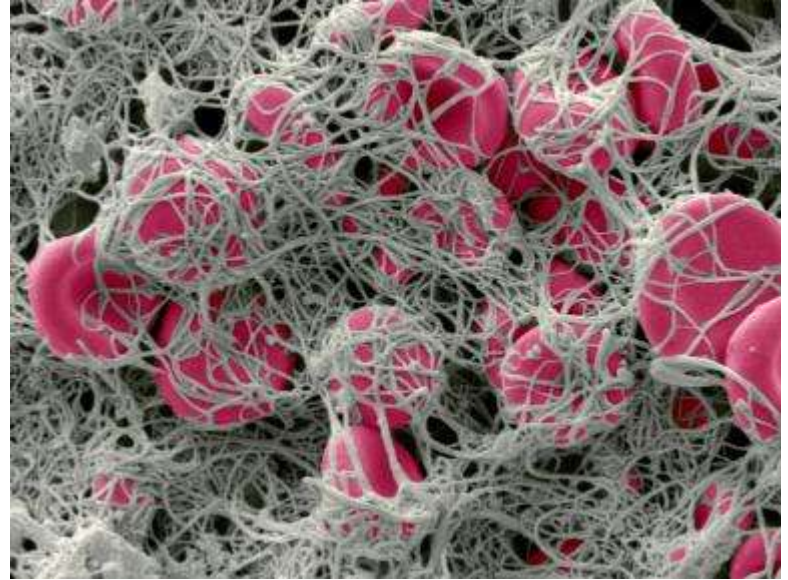
- Any constantly used drug that may cause bleeding (such as aspirin, nonsteroidal anti-inflammatory drugs, warfarin) or marrow suppression (methotrexate)
- Previous surgery
- Injections
- Chiropractic
- Exercise/PT (Physical Therapy)
- ER (Emergency Room)
- Massage therapy



[Leukemia](#)

Interviewing of the patient: any constantly used medications

- Drugs prescribed for diabetes mellitus, hypertension, cardiac disorders, hormonal disorders, cancer, arthritis, immunopathological processes, psychiatric disorders, etc.



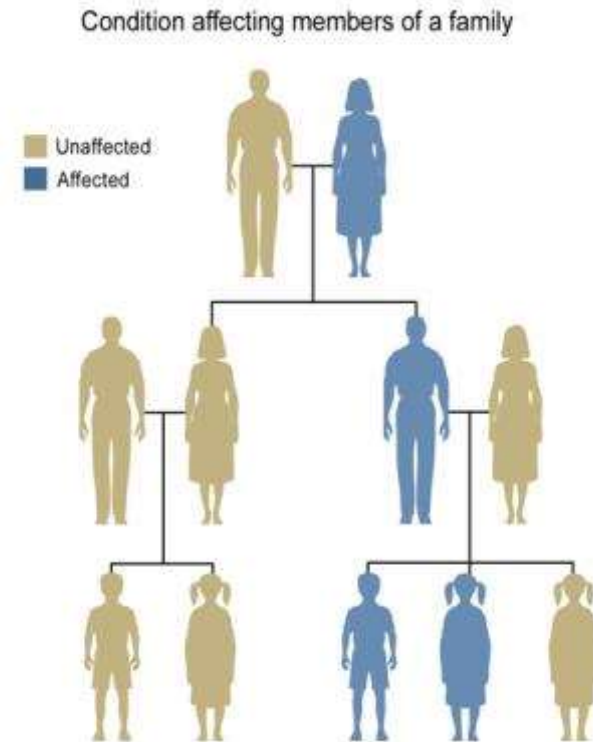
Interviewing of the patient: previous treatment and present status

- Previous Treatment
 - What?
 - Where?
 - When?
 - By whom?
- Present Status
 - Better vs. same vs. worse



Interviewing of the patient: family history and genetic risk

- A blood disorder in a member of the person's family
- The physician will inquire about the health of the patient's parents, brothers, sisters and children
- A family history of the diseases of the blood may be relevant to the underlying problem



Interviewing of the patient: social history

- High-risk behaviors
 - Alcohol, tobacco, or drug abuse
 - Depression
 - Violence
 - Sedentary lifestyle
 - Exposures to a chemical agents that could cause bleeding or damage the bone marrow
- Signs of any of the above behaviors may warrant referral to a secondary provider



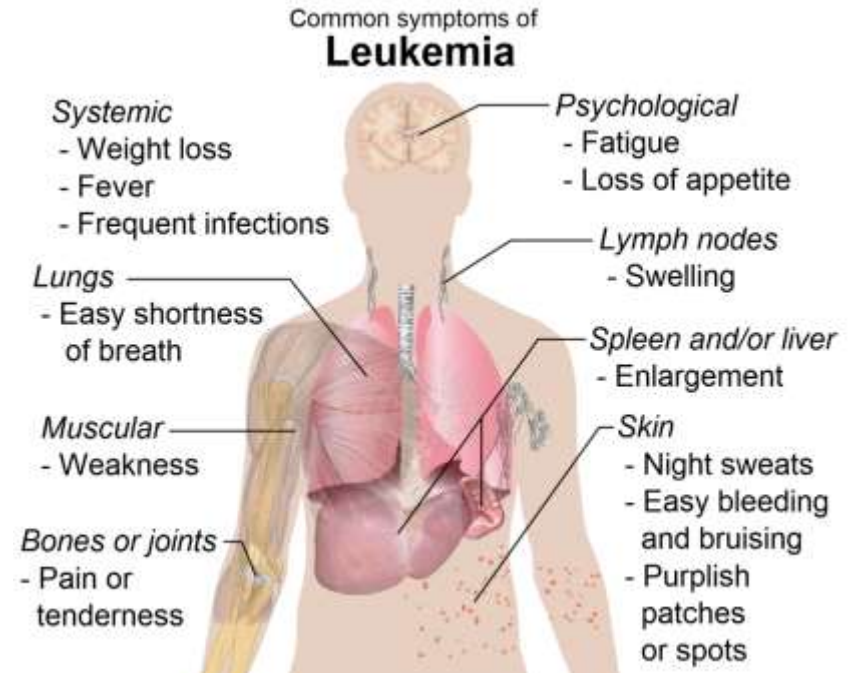
Interviewing of the patient: why take a medical history?

- Up to 90% of conditions can be accurately diagnosed or recognized by conducting a thorough medical history and listening carefully to the patient's response(s)
- Determines the necessary tests and measures you should prioritize for your objective examination



Interviewing of the patient: review of systems

- The "laundry list" of symptoms related to various organs of the body
- A series of questions helps seek out information that the patient may have neglected to provide the physician
- Review of systems helps to identify the patient's problem, or exclude different parts of the differential diagnosis



Interviewing of the patient: systemic enquiry

- General: fever, weight loss, loss of appetite, lethargy
- Respiratory and cardiovascular systems: shortness of breath, cough, hemoptysis, wheeze, chest pain
- Gastrointestinal system: nausea and vomiting, hematemesis, dysphagia, heartburn, jaundice, abdominal pain, change in bowel habit, rectal bleeding, tenesmus (sensation of incomplete bowel emptying)
- Genito-urinary system: dysuria (pain on passing urine), frequency, terminal dribbling, urethral discharge
- Gynecological system: pelvic pain, vaginal bleeding, vaginal discharge, LMP
- Neurological system: headaches, dizziness, loss of consciousness, fits, faints, funny turns, numbness, tingling, weakness, problems speaking, change in vision
- Musculoskeletal system and connective tissue: joint stiffness and swelling, muscle weakness, bone fractures, sensitivity to sunlight, malaise, cold and numb fingers or toes
- Rash

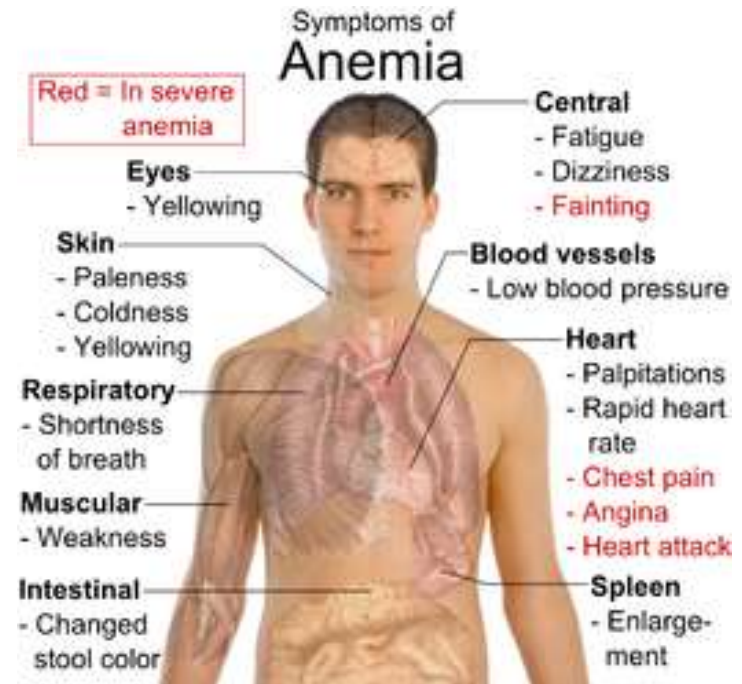
Interviewing of the patient: the Blood Diseases Quality of Life Indexes

Still expected !!!

Physical examination of the patient: the main points

Look for specific findings that can be related to a blood disorder:

- Examine the skin and mucous membranes (such as the inner surface of the eyelids or the mouth), looking for paleness, abnormal blood vessels (telangiectasias), bruises, small red or purple spots, or red rashes
- Control the neck, underarm, and groin areas for enlargement of lymph nodes
- Examine the joints to see if they are tender or swollen
- Investigate the abdomen, feeling for enlargement of the spleen or liver
- Do a rectal examination to check the stool for blood



Physical examination of the patient: do not do it without looking at the patient

- Too often, the physician rushes into the physical examination without looking at the patient for an unusual habitus or appearance of underdevelopment, malnutrition, or chronic illness
- These findings can be important clues to the underlying etiology of disease and provide information related to the duration of illness
- The skin and mucous membranes are often bypassed, so that pallor, abnormal pigmentation, icterus, spider nevi, petechiae, purpura, angiomas, ulcerations, palmar erythema, coarseness of hair, puffiness of the face, thinning of the lateral aspects of the eyebrows, nail defects, and a usually prominent venous pattern on the abdominal wall are missed in the rush to examine the heart and the lungs



Myelofibrosis

Physical examination of the patient: helpful in planning additional studies

- Examine optic fundi carefully but not at the expense of the conjunctivae and the sclerae, which can show pallor, icterus, splinter hemorrhages, petechiae, comma signs in the conjunctival vessels, or telangiectasia that can be helpful in planning additional studies



Subconjunctival hemorrhage

Physical examination of the patient: unilateral edema may portend lymphatic obstruction due to a malignancy

- Perform systematic examination for palpable enlargement of lymph nodes for evidence of infection or neoplasia
- Bilateral edema is useful in disclosing underlying cardiac, renal, or hepatic disease, whereas unilateral edema may portend lymphatic obstruction due to a malignancy that cannot be observed or palpated.



**Enlargement of one or more
lymph nodes under the arm**

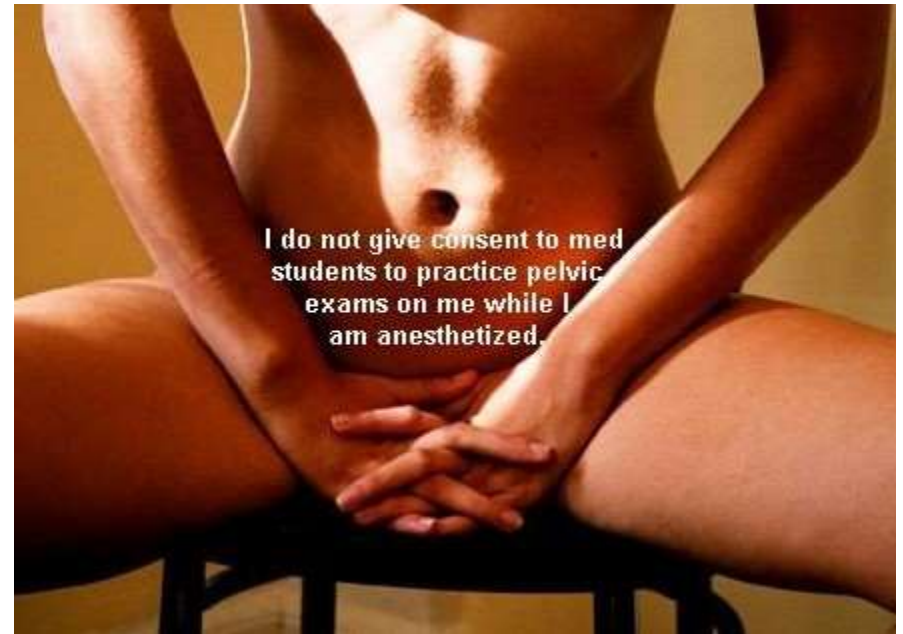
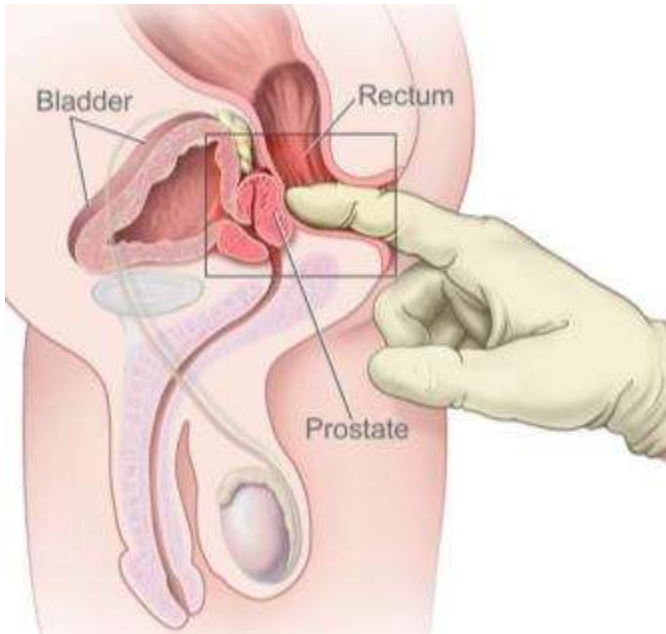
Physical examination of the patient: search for hepatomegaly and splenomegaly

- Carefully search for hepatomegaly and splenomegaly
- Their presence or absence is important, as are the size, the tenderness, the firmness, and the presence or the absence of nodules
- Splenomegaly is the most common physical finding in patients with leukemia
- Hepatomegaly also occurs, although less commonly than splenomegaly



Myelofibrosis

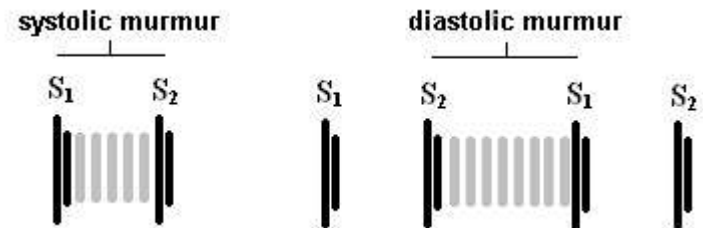
Physical examination of the patient: a rectal and pelvic examination cannot be neglected



A rectal and pelvic examination cannot be neglected, because tumor or infection of these organs can be the cause of anemia

Physical examination of the patient: the heart and nerves should not be ignored

- The neurologic examination should include tests of position sense and vibratory sense, examination of the cranial nerves, and testing for tendon reflexes
- The heart should not be ignored, because enlargement may provide evidence of the duration and the severity of the anemia, and murmurs may be the first evidence of a bacterial endocarditis that could explain the etiology of the anemia



Instrumental methods: imaging studies

- Imaging studies include X-ray, magnetic resonance imaging (MRI), ultrasound, and computed^d tomography (CT)
- X-ray ordinary is used in investigation of blood diseases on such body parts as bones
- MRI is used in the brain investigation
- Ultrasound is used in the kidneys, spleen, and liver investigation
- Computed^d tomography is used to check lymph nodes in the chest



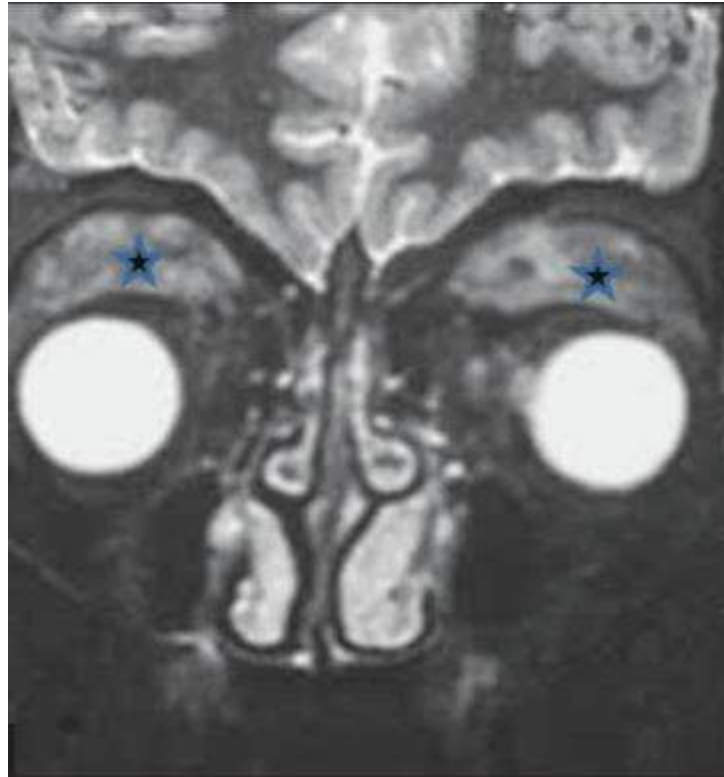
Computed Tomography

Instrumental methods: X-ray

- Chest x-ray from a patient with hairy cell leukemia shows a diffuse interstitial infiltrate
- In these patients, this appearance is often due to infection
- Here, however, the patient was found to have metastatic squamous cell carcinoma on bronchoscopy



Instrumental methods: magnetic resonance imaging



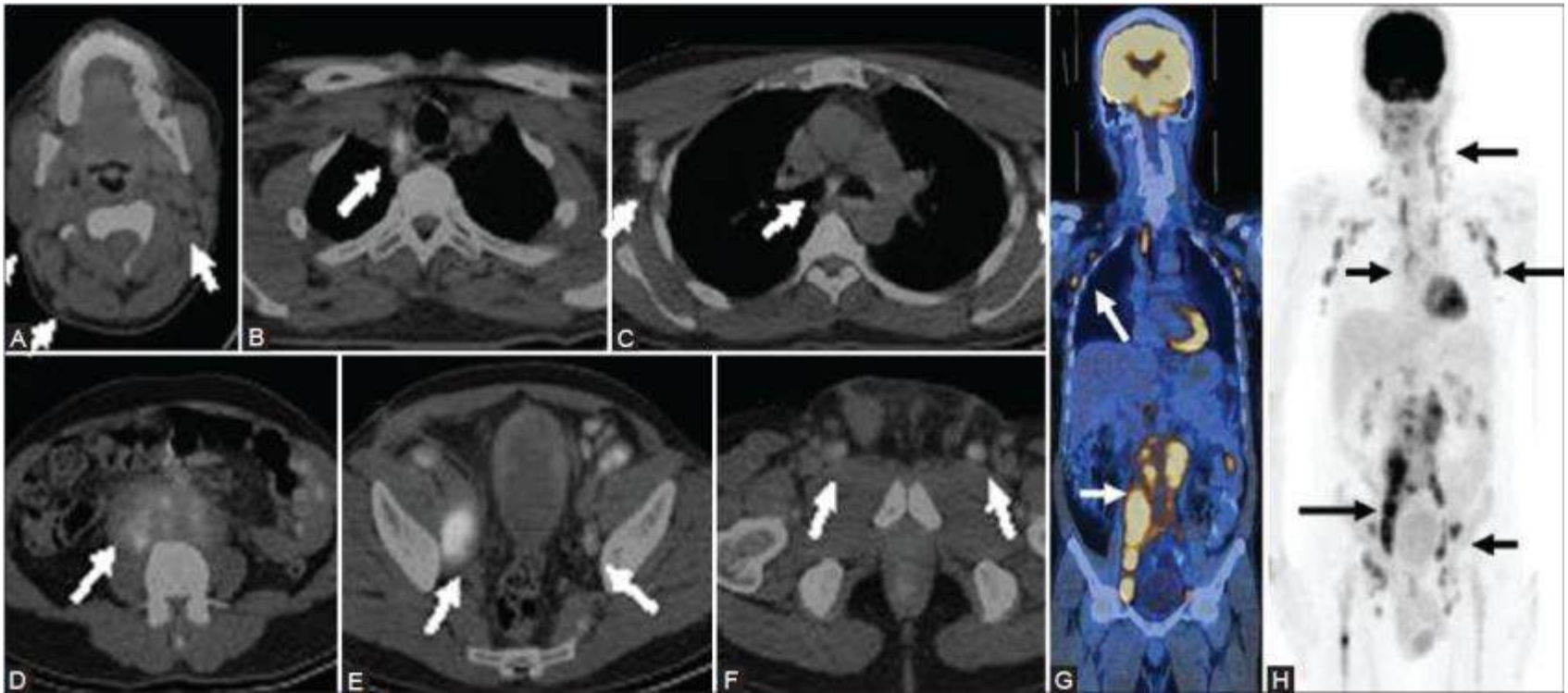
Orbital leukemic deposits in patient with acute lymphocytic leukemia (ALL)

Instrumental methods: ultrasound



Malignant lesions of the spleen: chronic lymphatic leukemia

Instrumental methods: computer tomography



Extranodal lymphoma

Laboratory methods: blood tests

- Complete blood count (CBC), including platelet and reticulocyte count
- Peripheral blood smear (examination of a sample of blood under a microscope)
- Erythrocyte (Red Blood Cells – RBC) sedimentation rate (ESR)
- Ferritin
- Serum iron
- Transferrin
- RBC folate level
- Serum vitamin B₁₂
- Hemoglobin electrophoresis
- Prothrombin time (PT), partial thromboplastin time (PTT), fibrinogen

Laboratory methods: blood tests (complete blood count)

- A complete blood count (CBC), also known as a complete blood cell count, full blood count (FBC), or full blood exam (FBE), is a blood panel that gives information about the cells in a patient's blood, such as the cell count for each cell type and usually includes:
 - Red blood cell (RBC) count
 - Hematocrit (HCT, packed cell volume, PCV)
 - Hemoglobin (Hgb)
 - Red blood cell indices
 - White blood cell types (WBC differential)
 - Platelet (thrombocyte) count
 - Mean platelet volume (MPV)

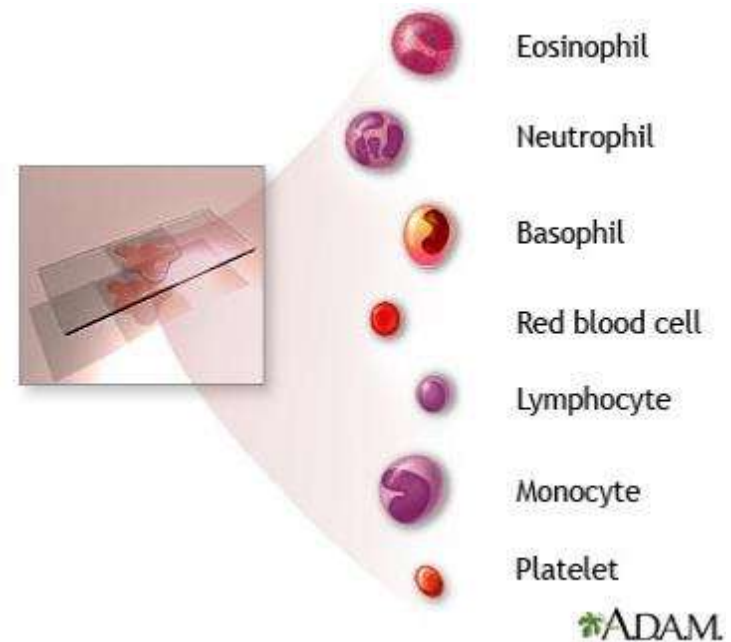
Laboratory methods: blood tests (peripheral blood smear)

- A blood smear is often used as a follow-up test to abnormal results on a complete blood count (CBC) to evaluate the different types of blood cells. It may be used to help diagnose and/or monitor numerous conditions that affect blood cell populations
- There are many diseases, disorders, and deficiencies that can affect the number and type of blood cells produced, their function, and their lifespan: anemia, myeloproliferative neoplasms, bone marrow disorders, leukemia, etc.



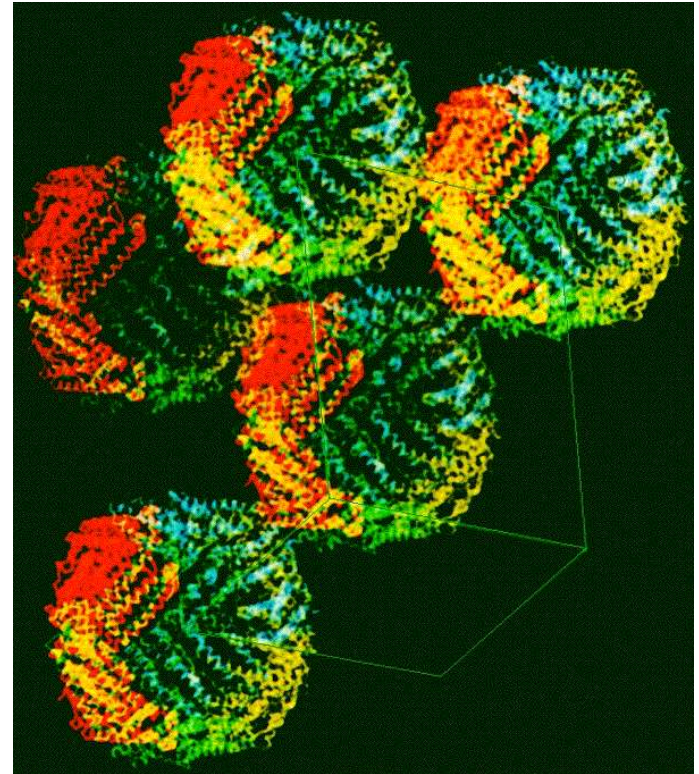
Laboratory methods: blood tests (erythrocyte sedimentation rate)

- The erythrocyte sedimentation rate (ESR) is the rate at which red blood cells sediment in a period of one hour
- The ESR is increased in inflammation, pregnancy, anemia, autoimmune disorders, infections, some kidney diseases and some cancers (such as lymphoma and multiple myeloma)
- The ESR is decreased in polycythemia, hyperviscosity, sickle cell anemia, leukemia, low plasma protein (due to liver or kidney disease) and congestive heart failure
- The basal ESR is slightly higher in females



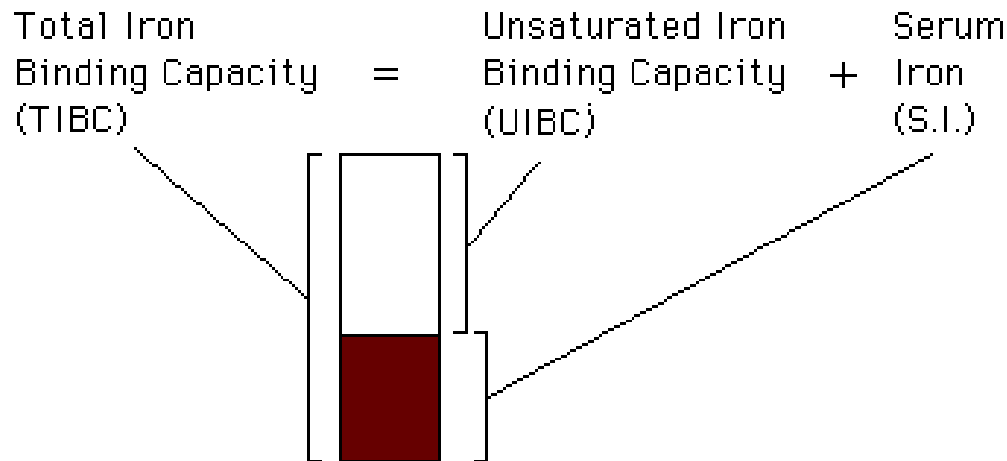
Laboratory methods: blood tests (ferritin)

- Ferritin is an ubiquitous intracellular protein that stores iron and releases it in a controlled fashion
- Serum ferritin levels are measured as part of the iron studies workup for Iron-deficiency
- A normal ferritin blood levels can vary between laboratories but are usually between 30–300 ng/mL ($=\mu\text{g/L}$) for males, and 18–115 ng/mL ($=\mu\text{g/L}$) for females



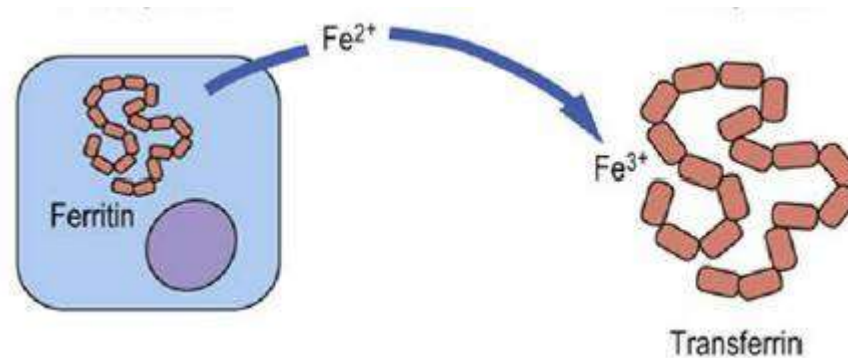
Laboratory methods: blood tests (serum iron)

Serum Iron and Iron Binding Capacity



- Serum iron is a medical laboratory test that measures the amount of circulating iron that is bound to transferrin
- Clinicians order this laboratory test when they are concerned about iron deficiency, which can cause anemia and other problems
- Normal reference ranges: in men - 65 – 176, in women - 50 - 170 ($\mu\text{g/dL}$)

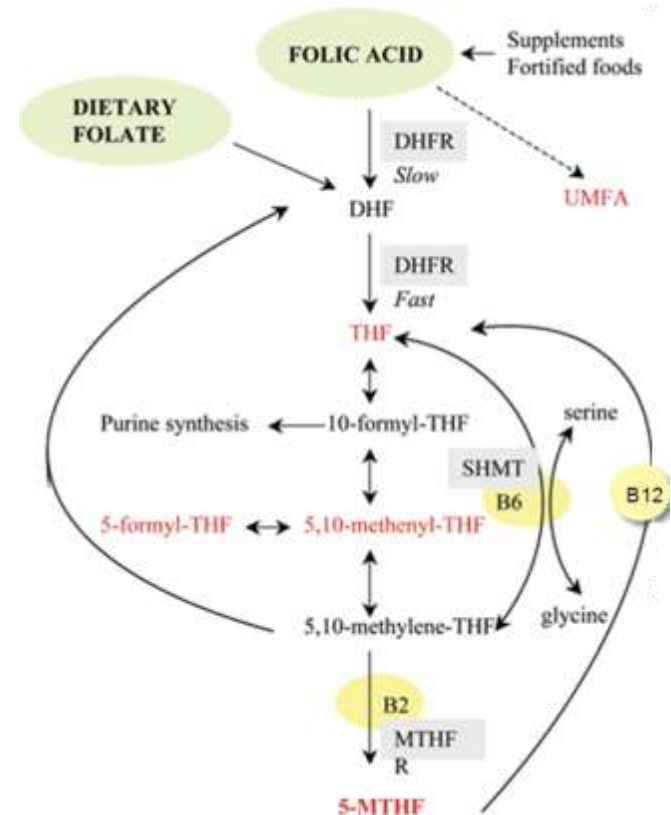
Laboratory methods: blood tests (transferrin)



- Human transferrins are iron-binding blood plasma glycoproteins, that are encoded by the *TF* gene and control the level of free iron in biological fluids
- An increased plasma transferrins level is often seen in patients suffering from iron deficiency anemia
- A decreased plasma transferrins level can occur in iron overload diseases and protein malnutrition
- An absence of transferrin results from a rare genetic disorder (atransferrinemia), a condition characterized by anemia and hemosiderosis
- An reference range for transferrin is 204–360 mg/dL

Laboratory methods: blood tests (folic acid)

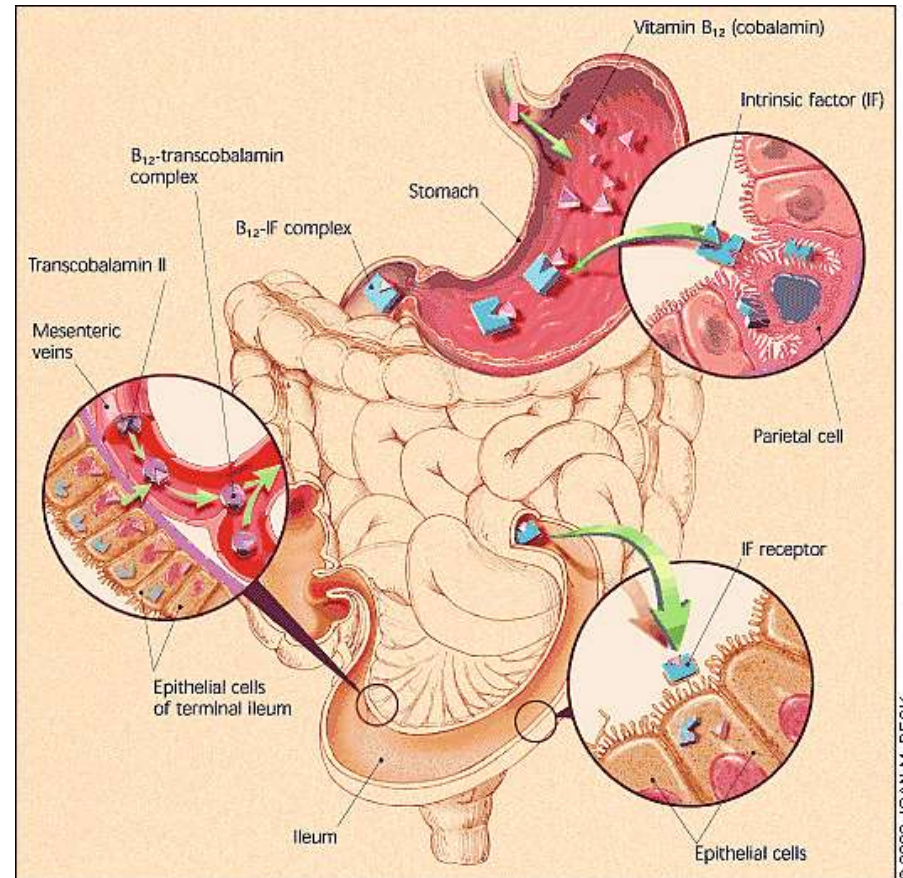
- Folic acid or folate is a B 9 vitamin
- A lack of dietary folates can lead to folate deficiency
- A complete lack of dietary folate takes months before deficiency develops as normal individuals have about 500–20,000 µg of folate in body stores
- Common symptoms of folate deficiency include diarrhea, macrocytic anemia with weakness or shortness of breath, peripheral neuropathy), psychiatric disorders (dementia, depression) etc.
- Folate deficiency during pregnancy increases the risk of neural tube defects of the fetus



Folic-acid-metabolism

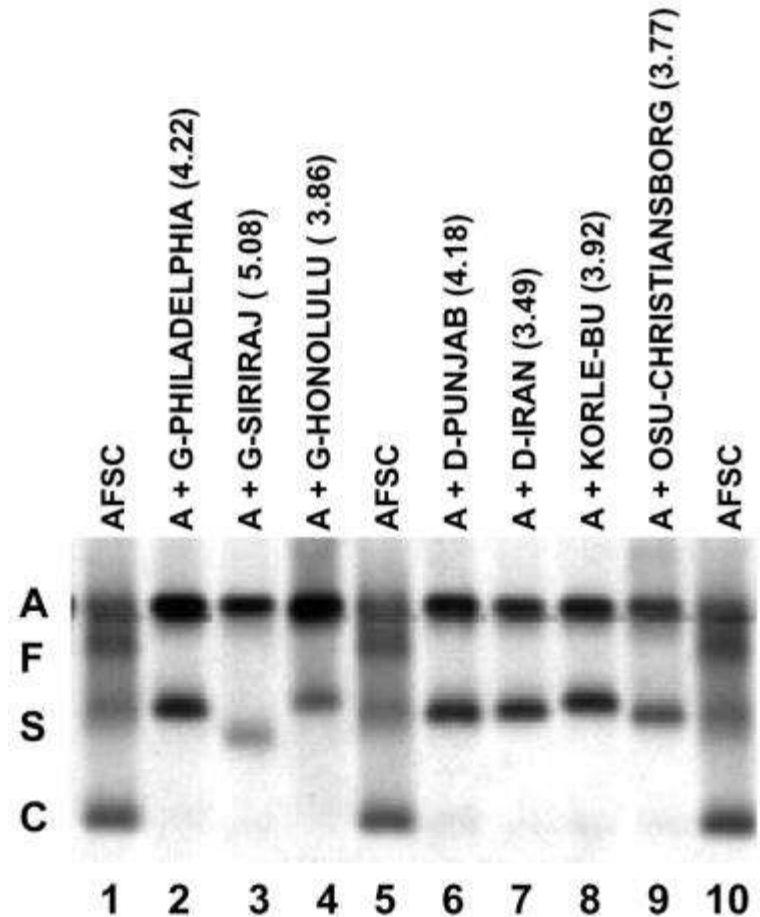
Laboratory methods: blood tests (serum vitamin B₁₂)

- Vitamin B₁₂, vitamin B12 or vitamin B-12, also called cobalamin, is a water-soluble vitamin with a key role in the normal functioning of the brain and nervous system, and for the formation of blood
- Vitamin B₁₂ was discovered from its relationship to pernicious anemia, which is an autoimmune disease
- Because intrinsic factor is crucial for the normal absorption of B₁₂, its lack in pernicious anemia causes a vitamin B₁₂ deficiency



Laboratory methods: blood tests (hemoglobin electrophoresis)

- Hemoglobin electrophoresis is a blood test that can detect different types of hemoglobin
- It uses the principles of gel electrophoresis to separate out the various types of hemoglobin and is a type of native gel electrophoresis
- The test can detect abnormal levels of hemoglobin, the form associated with sickle-cell disease, as well as other abnormal hemoglobin-related blood disorders, such as hemoglobin C
- It can also be used to determine whether there is a deficiency of any normal form of hemoglobin, as in the group of diseases known as thalassemias



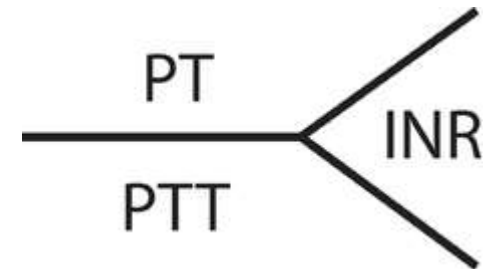
Laboratory methods: blood tests (prothrombin time)

- The prothrombin time (PT) and its derived measures of prothrombin ratio (PR) and international normalized ratio (INR) are measures of the extrinsic pathway of coagulation
- PT measures factors I (fibrinogen), II (prothrombin), V, VII, and X. It is used in conjunction with the activated partial thromboplastin time (aPTT) which measures the intrinsic pathway and common pathway
- They are used to determine the clotting tendency of blood, in the measure of warfarin dosage, liver damage, and vitamin K status



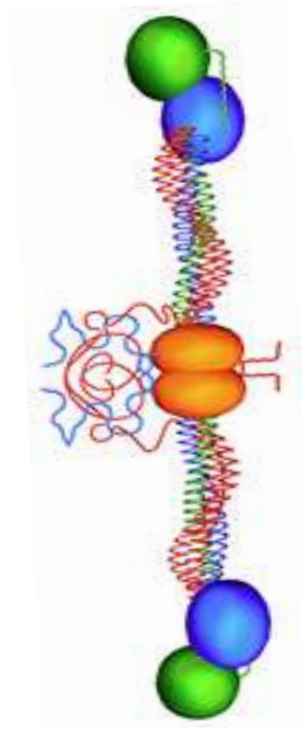
Laboratory methods: blood tests (partial thromboplastin time)

- The partial thromboplastin time (PTT) or activated partial thromboplastin time (aPTT or APTT) is a medical test that characterizes blood coagulation
- PTT is a performance indicator of the efficacy of both the "intrinsic" (now referred to as the contact activation pathway) and the common coagulation pathways
- PTT is used in conjunction with the prothrombin time (PT) which measures the extrinsic pathway
- Apart from detecting abnormalities in blood clotting, it is also used to examine coagulation factor deficiency (e.g. hemophilia)



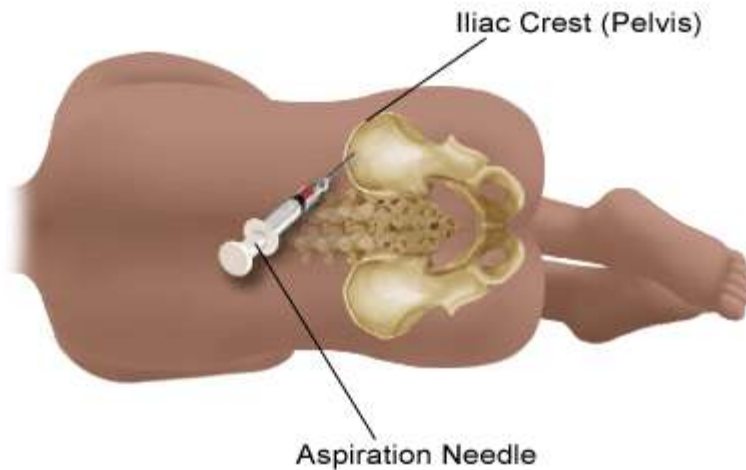
Laboratory methods: blood tests
(fibrinogen)

- Fibrinogen (factor I) is a glycoprotein in vertebrates that helps in the formation of blood clots
- The fibrinogen molecule is a soluble, large, and complex glycoprotein, 340 kDa plasma glycoprotein, that is converted by thrombin into fibrin during blood clot formation
- Fibrinogen levels can be measured in venous blood
- Normal levels are about 1.5-3 g/L, depending on the method used

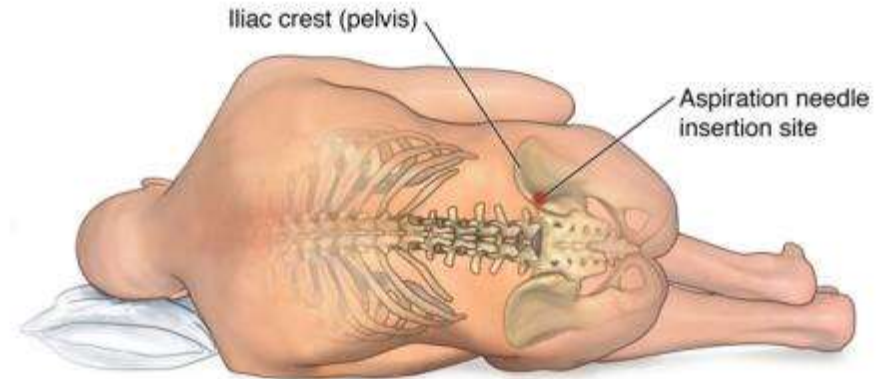


Laboratory methods: bone marrow aspiration and biopsy

Bone Marrow Aspiration



Bone marrow biopsy

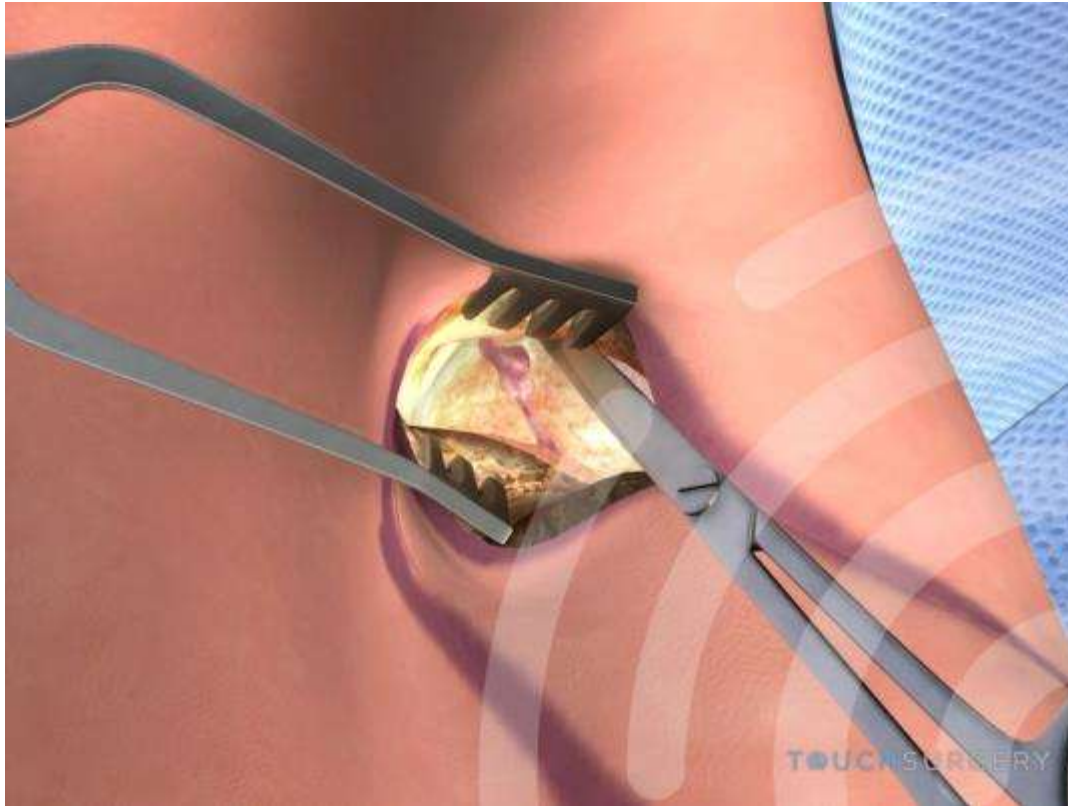


Laboratory methods: bone marrow examination

- Bone marrow examination refers to the analysis of samples of bone marrow obtained by bone marrow biopsy (a trephine biopsy) and bone marrow aspiration.
- Bone marrow examination is used in the diagnosis of a number of conditions, including leukemia, multiple myeloma, lymphoma, anemia, and pancytopenia

Comparison	Aspiration	Biopsy
Advantages	<ul style="list-style-type: none">•Fast•Gives relative quantity of different cell types•Gives material to further study, e.g. molecular genetics and flow cytometry	<ul style="list-style-type: none">•Gives cell and stroma constitution•Represents all cells•Explains cause of "dry tap" (aspiration gives no blood cells)
Drawbacks	Does not represent all cells	Slow processing

Laboratory methods: lymph node biopsy

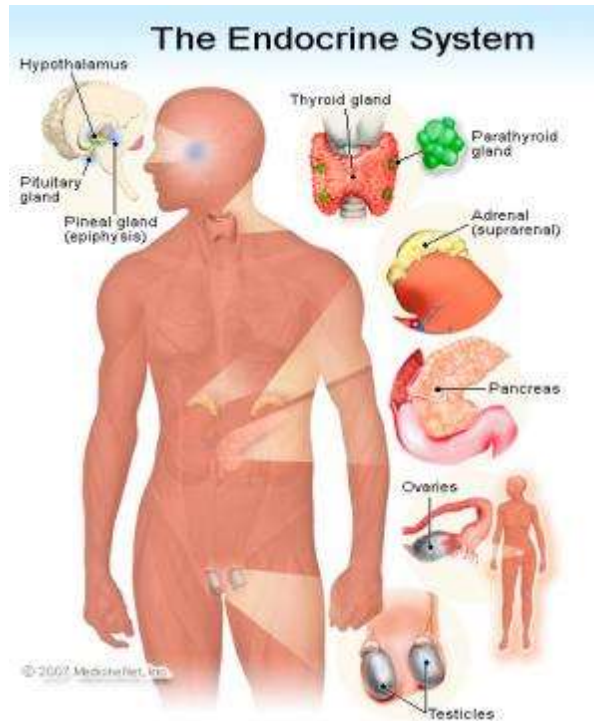


A lymph node biopsy can be performed to diagnose certain types of leukemia in certain situations

Lecture 10

Approach to the patient with affection and
disease of the endocrine system

Plan of the lecture

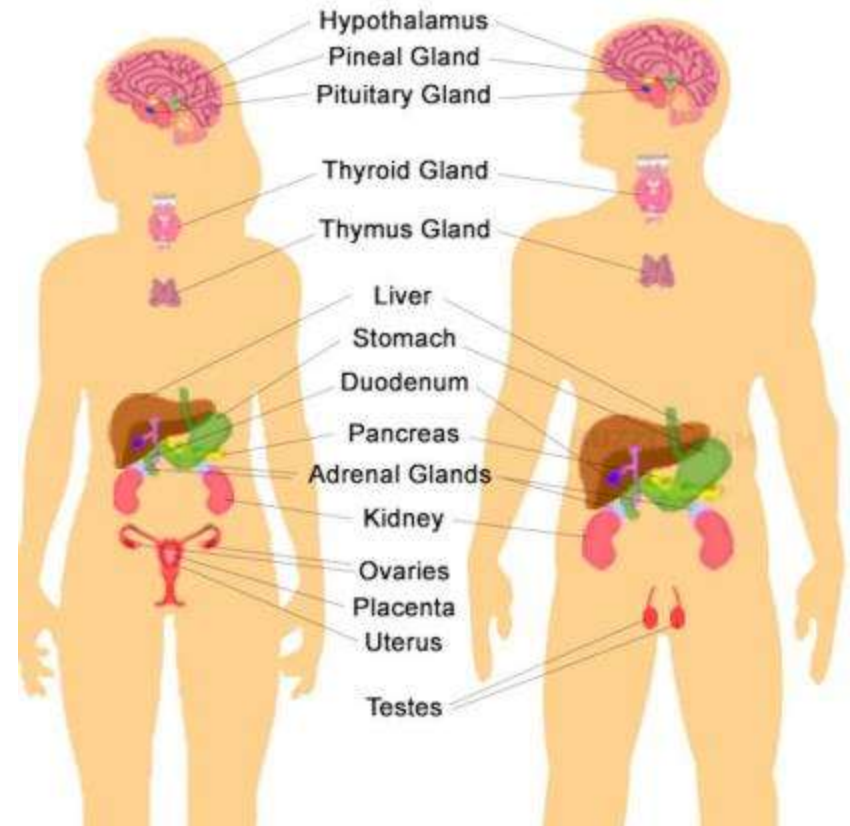


Approach to the Patient with Affection and Disease of the Endocrine System

- Endocrine system disorders definition
- Endocrine system disorders partial list
- Interviewing of the patient
- Physical examination of the patient
- Instrumental methods
- laboratory methods

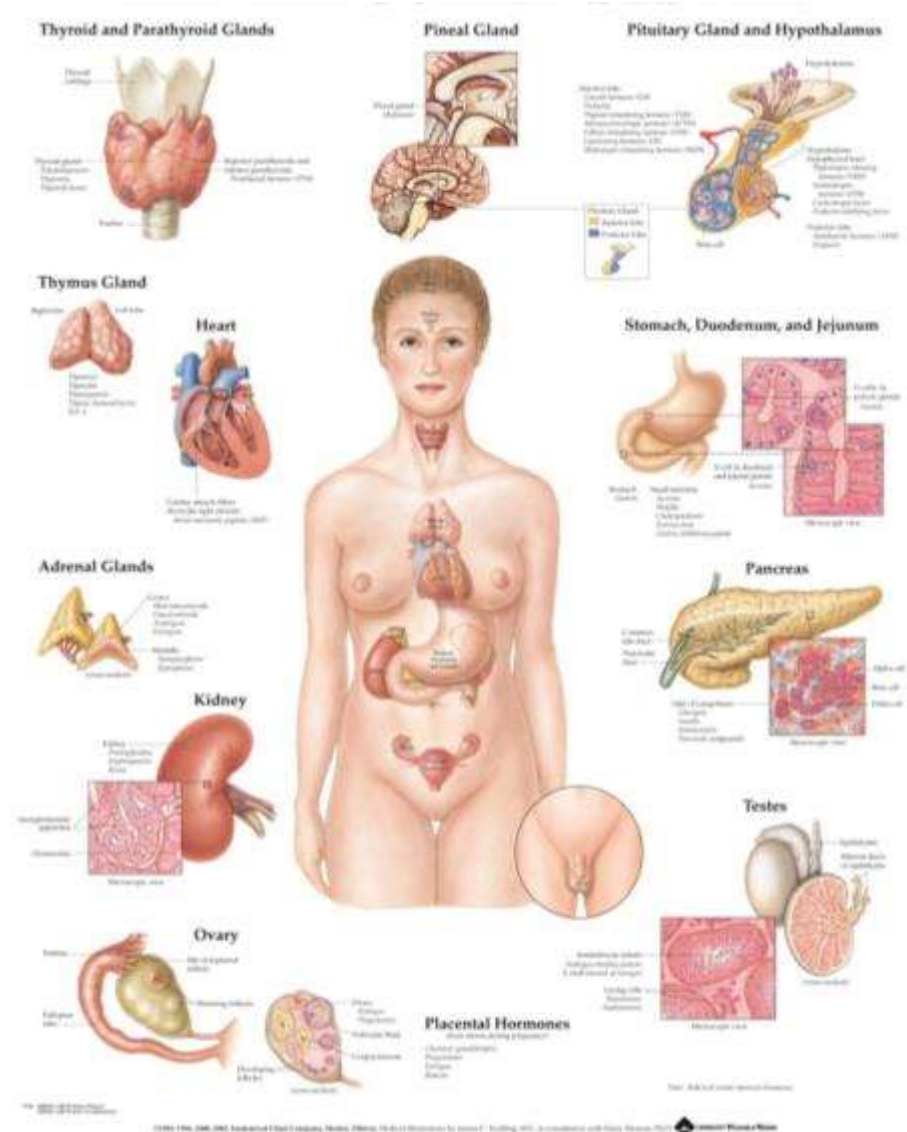
Endocrine system disorders definition

- The endocrine system is a network of glands that produce and release hormones that help control many important body functions, especially the body's ability to change calories into energy that powers cells and organs
- Endocrine disorders are typically grouped into three categories: 1) endocrine gland hyposecretion (leading to hormone deficiency), 2) endocrine gland hypersecretion (leading to hormone excess), 3) tumours of endocrine glands



Endocrine system disorders partial list

- [Addison disease and adrenal insufficiency](#)
- [Conn syndrome \(primary hyperaldosteronism\)](#)
- [Cushing syndrome](#) or disease
- [Diabetes mellitus](#)
- [Infertility](#)
- [Pituitary disorders](#)
- Polycystic Ovary Syndrome ([PCOS](#))
- [Thyroid diseases](#)



Endocrine glands, hormones and their function 1

ENDOCRINE GLAND	HORMONE(S) GLAND PRODUCE(S)	HORMONE FUNCTION
Hypothalamus		
	Growth hormone-releasing hormone (GHRH)	Stimulates growth hormone production by the pituitary
	Thyrotropin-releasing hormone (TRH)	Stimulates TSH production in the pituitary
	Corticotropin-releasing hormone (CRH)	Stimulates ACTH production by the pituitary
	Gonadotropin-releasing hormone (GnRH)	Stimulates LH and FSH production by the pituitary
	Prolactin inhibitory hormone (PIH, dopamine)	Inhibits prolactin production
	Oxytocin; produced by the hypothalamus; stored and secreted by the pituitary	Uterine contraction during labor
	Arginine vasopressin (AVP), also called antidiurectic hormone (ADH); produced by the hypothalamus; stored and secreted by the pituitary	Water balance

Endocrine glands, hormones and their function 2

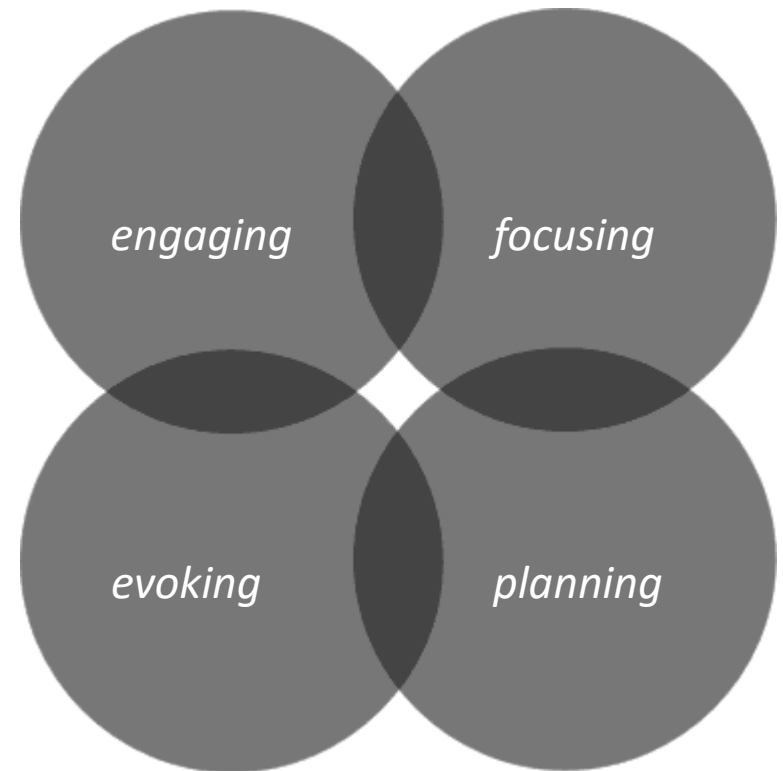
ENDOCRINE GLAND	HORMONE(S) GLAND PRODUCE(S)	HORMONE FUNCTION
Pituitary	Prolactin	Milk production (milk production not related to pregnancy is called galactorrhea and is usually due to high prolactin)
	Growth hormone (GH)	Stimulates childhood growth, cell production, helps maintain muscle and bone mass in adults
	ACTH	Stimulates cortisol production by the adrenal glands
	TSH	Stimulates thyroid hormone production
	LH , FSH	Regulation of testosterone and estrogen, fertility
Thyroid	T4 (thyroxine)	Help regulate the rate of metabolism
	T3 (triiodothyronine)	
	Calcitonin	Helps regulate bone status, blood calcium
Parathyroid	Parathyroid hormone (PTH)	Regulates blood calcium

Endocrine glands, hormones and their function 3

ENDOCRINE GLAND	HORMONE(S) GLAND PRODUCE(S)	HORMONE FUNCTION
Adrenal	Epinephrine (adrenaline) Norepinephrine (Catecholamines)	Blood pressure regulation, stress reaction, heart rate
	Aldosterone	Salt, water balance
	Cortisol	Stress reaction
	DHEA-S	Body hair development at puberty
Ovaries (females only)	Estrogen	Female sexual characteristics
	Progesterone	
Testicles (males only)	Testosterone	Male sexual characteristics
Pancreas	Insulin Glucagon Somatostatin	Glucose regulation
Pineal	Melatonin	Not well understood; Helps control sleep patterns, affects reproduction

Interviewing of the patient: four overlapping processes

1. *Engaging* (connecting with patients and establishing a good working relationship)
2. *Focusing* (agreeing on the target of motivational enhancement and directing the conversation toward it)
3. *Evoking* (drawing out the patients' own motivations for changing the target behavior)
4. *Planning* (developing commitment to change and formulating a specific plan of action)



Interviewing of the patient: Good questions to get started on the core interview



Communication skills:

- Active listening
- Empathy
- Building rapport
- Open-ended questions
- Leading questions
- Silence
- “Why” questions
- Nonverbal communication cues

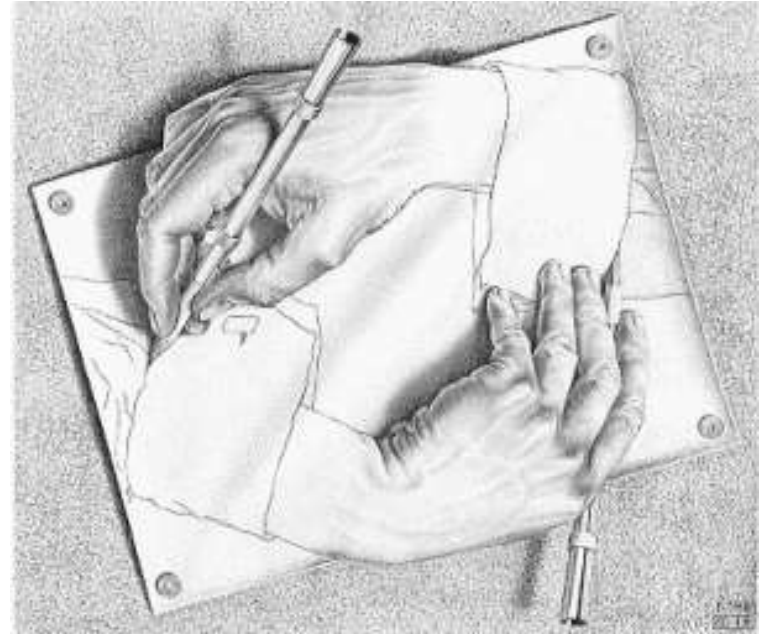
Interviewing of the patient: Good questions to get started on the core interview

- What is your chief complaint?
- Tell me why you're here today
- Tell me about your injury
- What can I do to help you?
- Explain to me your understanding of your injury



Interviewing of the patient: Patient profile

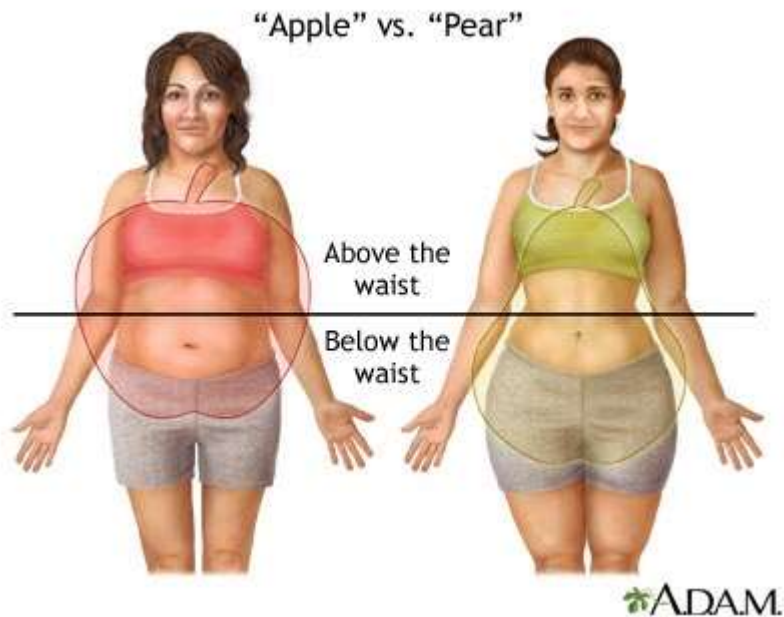
- Age
- Sex
- Race/Ethnicity
- Handedness
- Ht-Wt-BMI-Body type
- Primary language
- Barriers to learning
- Learning preference
- Unique rehabilitation goals



Interviewing of the patient: general endocrine signs and symptoms

- When the endocrine glands or its hormones malfunction, a number of signs and symptoms may arise
- A disease of a specific endocrine gland or dysfunction of one or more of its hormones may cause very specific signs and symptoms
- List of general endocrine signs and symptoms is short:
- Weight gain (hypothyroidism, ovarian disorders, any condition that causes an excess of glucocorticoids, etc.
- Weight loss (hyperthyroidism, diabetes mellitus, adrenal insufficiency)
- Alterations in facial structure may be due to diabetes mellitus, polycystic ovary syndrome (PCOS), Cushing's syndrome or acromegaly (excess growth hormone)
- Sexual/Reproductive Disorders (in both men and women, dysfunction with the gonads (ovaries in women, testes in men), pituitary dysfunction - follicle-stimulating hormone/luteinizing hormone (FSH/LH), thyroid dysfunction, diabetes, etc.)

Interviewing of the patient: weight gain



Different types of weight gain



Weight gain caused by Andropause

Interviewing of the patient: weight loss



Adrenal fatigue weight loss

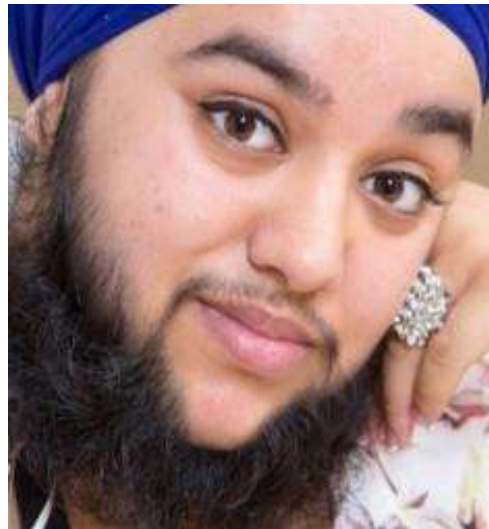


Addison's Disease weight loss

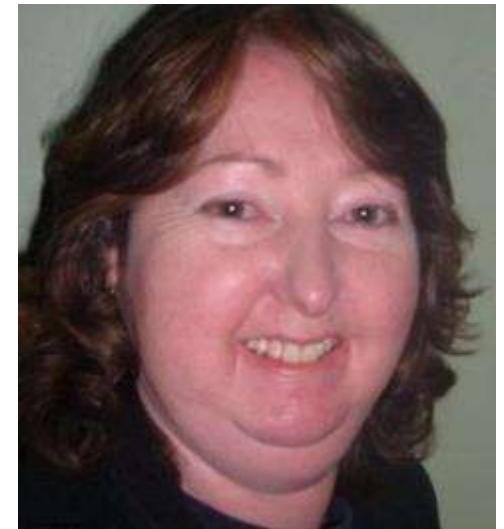
Interviewing of the patient: alterations in facial structure



Acromegaly



Polycystic Ovary Syndrome



Cushing's syndrome

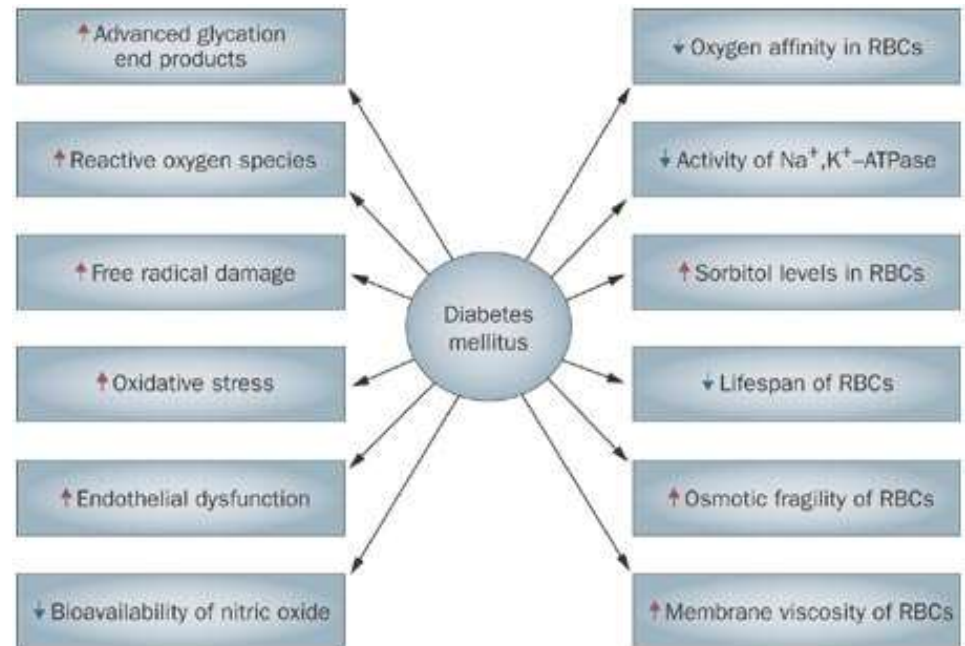
Interviewing of the patient: sexual/reproductive disorders



Yoga poses for Reproductive organs

Interviewing of the patient: common symptoms of diabetes

- Diabetes mellitus occurs when the pancreas either does not produce sufficient insulin or the body cannot use the available insulin
- Symptoms of both type 1 and type 2 diabetes include:
 - Excessive thirst or hunger
 - Fatigue
 - Frequent urination
 - Nausea and vomiting
 - Unexplained weight loss or gain
 - Vision changes

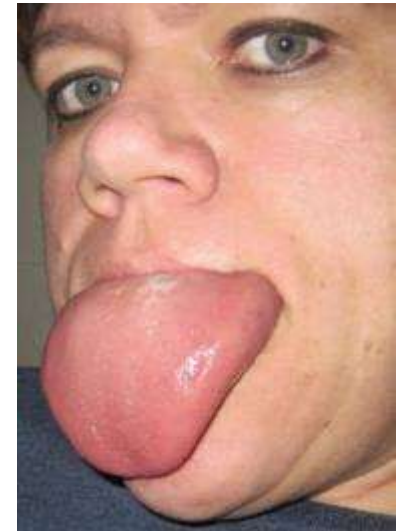


Interviewing of the patient: common symptoms of acromegaly

Acromegaly is a disorder in which the pituitary gland overproduces growth hormone. This leads to symptoms of overgrowth, especially of the hands and feet. Symptoms of acromegaly include:

- Abnormally large lips, nose or tongue
- Abnormally large or swollen hands or feet
- Altered facial bone structure
- Body and joint aches
- Deep voice
- Fatigue and weakness
- Headaches
- Overgrowth of bone and cartilage and thickening of the skin
- Sexual dysfunction, including decreased libido
- Sleep apnea
- Vision impairment

Interviewing of the patient: common symptoms of acromegaly



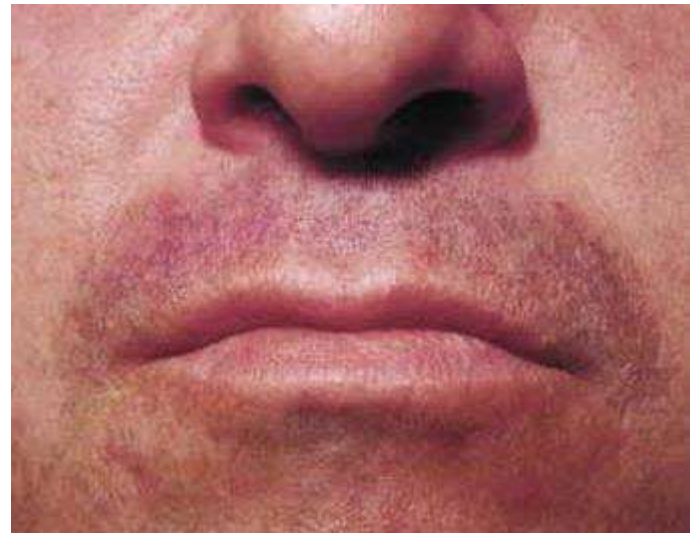
Abnormally large lips, nose, tongue

Interviewing of the patient: common symptoms of Addison's disease

Addison's disease is characterized by decreased production of cortisol and aldosterone due to adrenal gland damage. Common symptoms of Addison's disease include:

- Depression
- Diarrhea
- Fatigue
- Headache
- Hyperpigmentation of the skin (bronze appearance)
- Hypoglycemia (low blood glucose)
- Loss of appetite
- Low blood pressure (hypotension)
- Missed menstrual periods
- Nausea, with or without vomiting
- Salt cravings
- Unexplained weight loss
- Weakness (loss of strength)

Interviewing of the patient: common symptoms of Addison's disease



Hyperpigmentation of the skin (bronze appearance)

Interviewing of the patient: common symptoms of Cushing's syndrome

Cushing's syndrome arises from excess cortisol, produced by the adrenal glands. Symptoms of Cushing's syndrome include:

- Buffalo hump (fat between the shoulder blades)
- Skin discoloration such as bruising
- Red striae (irregular areas of skin that look like bands, stripes, or lines)
- Fatigue
- Feeling very thirsty
- Thinning and weakening of the bones (osteoporosis)
- Frequent urination
- High blood sugar (hyperglycemia)
- High blood pressure (hypertension)
- Irritability and mood changes
- Obesity of the upper body
- Rounded "moon" face
- Weakness (loss of strength)

Interviewing of the patient: common symptoms of Cushing's syndrome



Buffalo hump



Striations



Rounded "moon" face

Interviewing of the patient: common symptoms of Graves' disease

Graves' disease is a type of hyperthyroidism resulting in excessive thyroid hormone production. Common symptoms of Graves' disease include:

- Bulging eyes (Graves' ophthalmopathy)
- Diarrhea
- Difficulty sleeping
- Fatigue and weakness
- Goiter (enlargement of the thyroid gland)
- Heat intolerance
- Irregular heart rate
- Irritability and mood changes
- Rapid heart rate (tachycardia)
- Thick or red skin on the shins
- Tremors
- Unexplained weight loss

Interviewing of the patient: common symptoms of Graves' disease



Bulging eyes



Goiter



Thick or red skin on the shins

Interviewing of the patient: common symptoms of Hashimoto's thyroiditis

Hashimoto's (autoimmune) thyroiditis is a condition in which the thyroid is targeted by the immune system, leading to hypothyroidism and low production of thyroid hormone. Often disease is symptomless, but symptoms can include:

- Cold intolerance
- Constipation
- Dry hair and loss of hair
- Fatigue
- Goiter (enlargement of the thyroid gland)
- Joint and muscle pain
- Missed menstrual periods
- Slowed heart rate
- Weight gain



Interviewing of the patient: common symptoms of hyperthyroidism

Hyperthyroidism is a condition characterized by an overactive thyroid gland. Common symptoms of hyperthyroidism include:

- Diarrhea
- Difficulty sleeping
- Fatigue
- Goiter (enlargement of the thyroid gland)
- Heat intolerance
- Irritability and mood changes
- Rapid heart rate (tachycardia)
- Tremors
- Unexplained weight loss
- Weakness (loss of strength)



Interviewing of the patient: common symptoms of hypothyroidism

Hypothyroidism is a condition in which the thyroid is underactive and produces too little thyroid hormone. Common symptoms include:

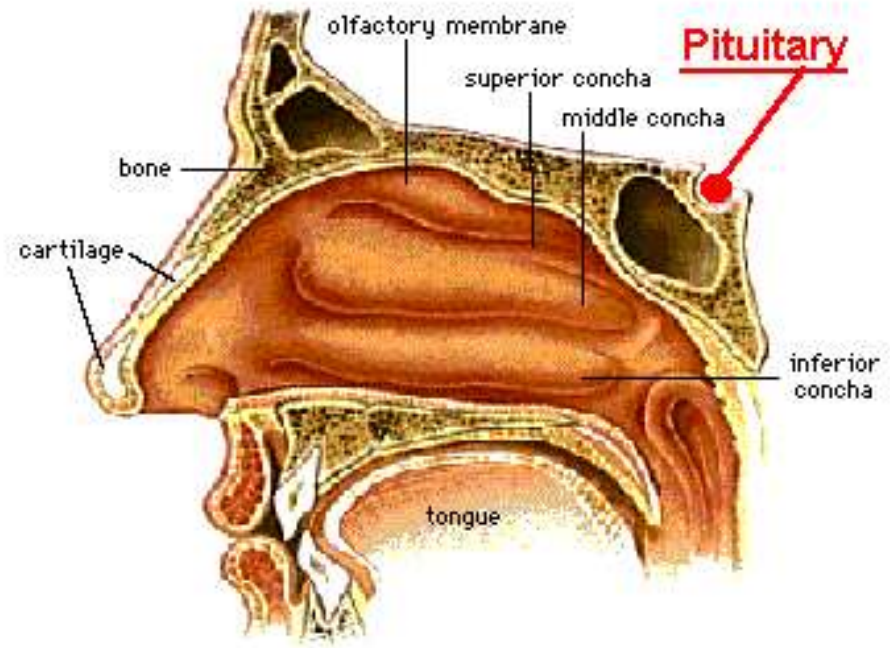
- Cold intolerance
- Constipation
- Decreased sweat production
- Dry hair
- Fatigue
- Goiter (enlargement of the thyroid gland)
- Joint and muscle pain
- Missed menstrual periods
- Slowed heart rate
- Swollen face
- Unexplained weight gain



Interviewing of the patient: common symptoms of prolactinoma

Prolactinoma arises when a dysfunctional pituitary gland makes excess prolactin hormone, which functions in the production of breast milk. Excess prolactin can lead to symptoms such as:

- Erectile dysfunction
- Infertility
- Loss of libido
- Missed menstrual periods
- Unexplained milk production



Interviewing of the patient: serious symptoms that might indicate a life-threatening condition

- Confusion or loss of consciousness for even a brief moment
- Dangerously low or high blood pressure (extreme hypotension or hypertensive crisis)
- Dangerously slow or fast heart rate
- Dehydration
- Depression or anxiety
- Difficulty breathing
- Eye problems, including dryness, irritation, pressure, pain or bulging
- Severe fatigue or weakness
- Severe, unexplained headache
- Severe vomiting and diarrhea
- Hyperthermia
- Sleep disturbances



Interviewing of the patient: specific questions for set of complaints

Each of complaints will prompt a series of specific questions that will help arrive at a preliminary single diagnosis, or a group of different diagnoses



Interviewing of the patient: example of specific questions in complaint

- Character
- Location
- Severity
- Timing
- Duration
- Radiation
- Provocation
- Relieving conditions
- When did it first start?
- How often does it occur?
- Is it becoming more frequent with time?
- Were there associated symptoms
- Are the symptoms lasting longer?
- How the symptoms relate to food intake?

Interviewing of the patient: past medical history

In a medical encounter, a past medical history (abbreviated PMH), is the total sum of a patient's health status prior to the presenting problem

Weight

State

Secondary Insurance

Secondary Insurance

Past Medical History

Cardiac

☐ None

☐ Unknown

☐ Angina

☐ Arrhythmia

☐ Cardiomyopathy

☐ CHF

☐ Congenital

☐ Implanted Defib

☐ Other

Chronic Illnesses

Diabetes

Hypertension

Asthma

Chronic Renal

Intestinal

None

Unknown

Abdominal

Heart

Lung

Neurological

Interviewing of the patient: past medical history

Alimentary changes

- Weight loss (thyrotoxicosis, diabetes mellitus (DM 1 type)) vs. gain (Cushing's, hypothalamic disease, DM 2 type, hypothyroidism)
- Appetite: loss (Addison's) vs. increased (thyrotoxicosis)
- Diarrhea (hyperthyroid, Addison's)
- Constipation (hypothyroidism, hypercalcemia)
- Polydipsia [excess drinking] (DM, renal dz, hypercalcemia)

Integumental changes

- Pigmentation (hypopituitarism, Cushing's, acromegaly, Addison's)
- Dryness (hypothyroidism, hypoparathyroidism)
- Sweating (hyperthyroidism, pheochromocytoma, acromegaly)
- Overgrowth (acromegaly)

Interviewing of the patient: past medical history

Nervous changes

- Nervousness, irritability (thyrotoxicosis)
- Fatigue (hypothyroid, diabetes mellitus (DM), Addison's, acromegaly)
- Headaches (hypoglycemia)
- Seizures (hypoglycemia)
- Visual loss (acromegaly, DM)

Rheumatoid changes

- Shorter stature
- Gigantism (Marfan's, Klinefelter's, growth hormone)
- Hand, skull bony growth (acromegaly)

Urogenital changes

- Polyuria (DM, DI, polydipsia)
- Menstrual changes (polycystic ovary, pituitary disease)

Interviewing of the patient: prior or current treatment

- Any constantly used drug for hormonal disorders, hypertension, cardiac disorders, cancer, arthritis, immunopathological processes, psychiatric disorders, etc.
- Previous surgery (thyroid surgery, radiation, pituitary surgery, etc.)
- Injections
- Chiropractic
- Exercise/PT (Physical Therapy)
- ER (Emergency Room)
- Massage therapy



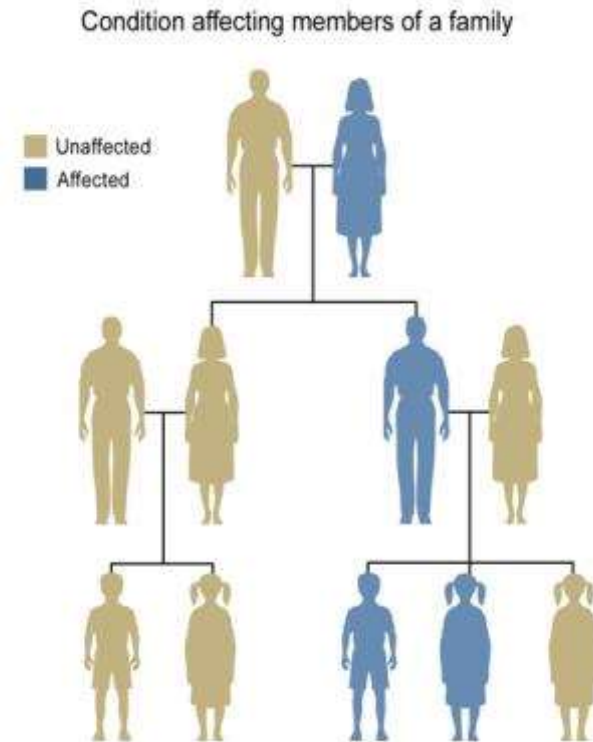
Interviewing of the patient: previous treatment and present status

- Previous Treatment
 - What?
 - Where?
 - When?
 - By whom?
- Present Status
 - Better vs. same vs. worse



Interviewing of the patient: family history and genetic risk

- An endocrine disorder in a member of the person's family
- The physician will inquire about the health of the patient's parents, brothers, sisters and children
- A family history of the diseases of endocrine system may be relevant to the underlying problem (multiple endocrine neoplasia (MEN) or congenital hypothyroidism)



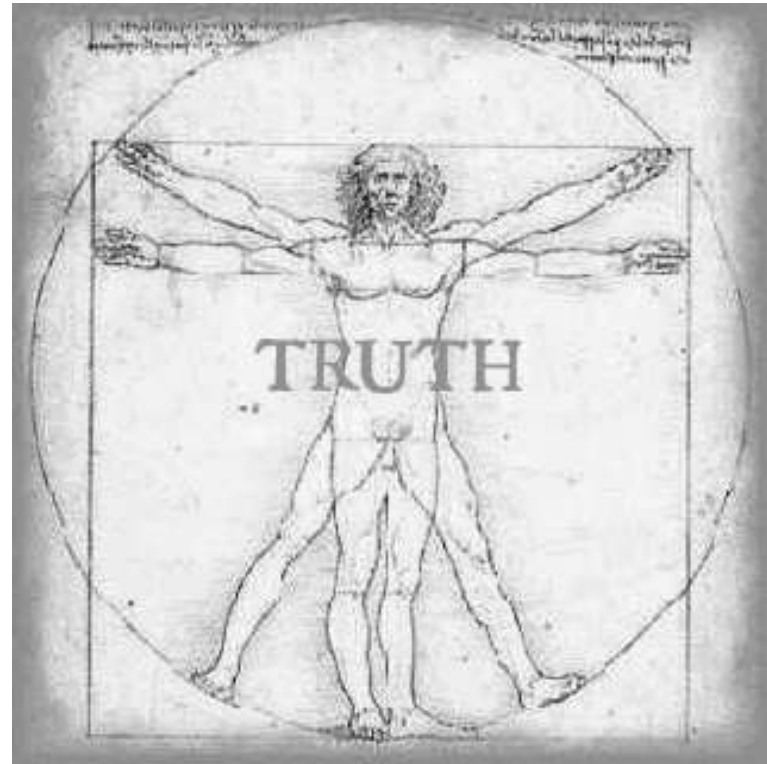
Interviewing of the patient: social history

- High-risk behaviors
 - Alcohol, tobacco, or drug abuse
 - Depression
 - Violence
 - Sedentary lifestyle
 - Exposures to physical or mental stressors
- Signs of any of the above behaviors may warrant referral to a secondary provider



Interviewing of the patient: why take a medical history?

- Up to 90% of conditions can be accurately diagnosed or recognized by conducting a thorough medical history and listening carefully to the patient's response(s)
- Determines the necessary tests and measures you should prioritize for your objective examination



The Truth about When Doctors Don't Tell the Truth

Interviewing of the patient: review of systems

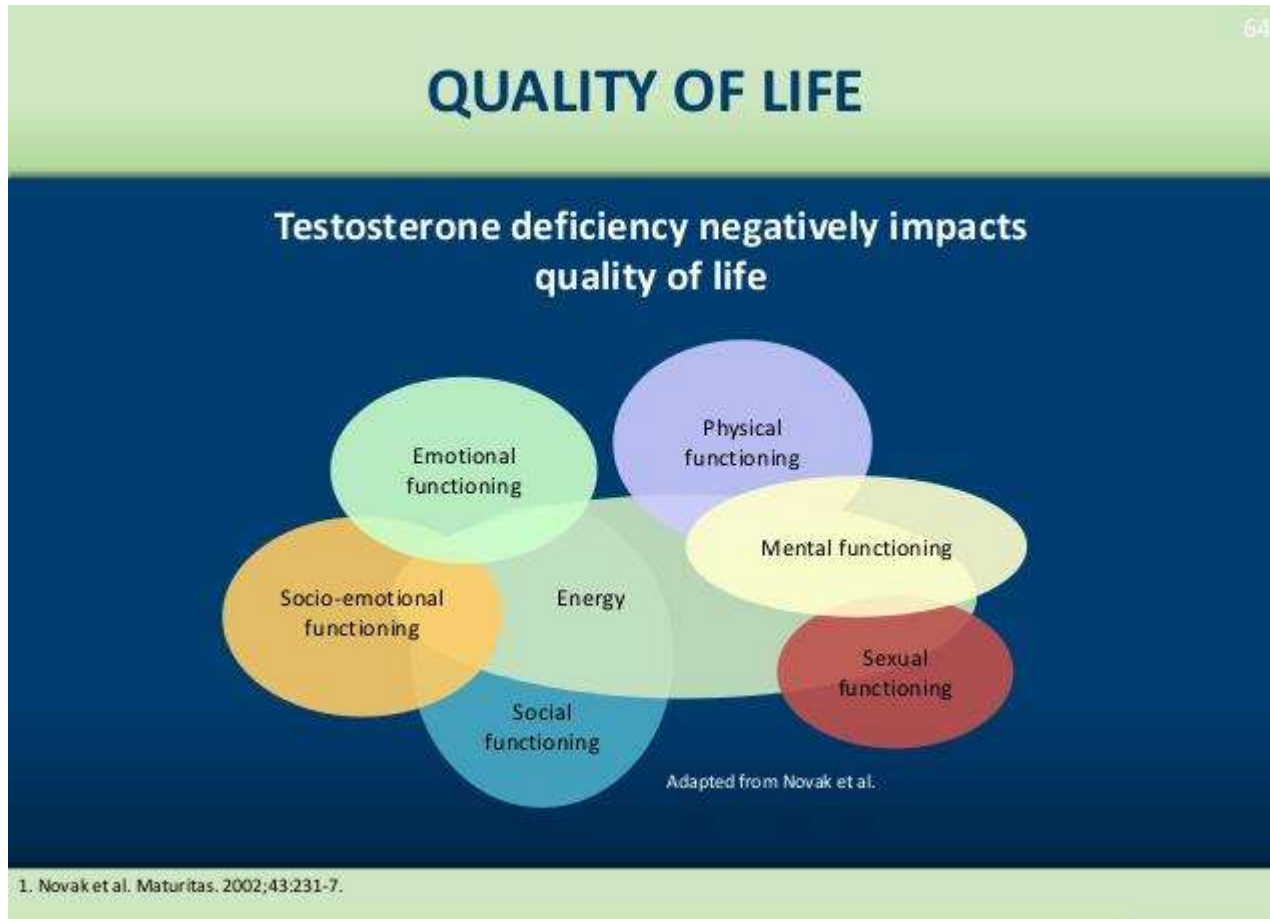
- The "laundry list" of symptoms related to various organs of the body
- A series of questions helps seek out information that the patient may have neglected to provide the physician
- Review of systems helps to identify the patient's problem, or exclude different parts of the differential diagnosis



Interviewing of the patient: systemic enquiry

- General: fever, weight loss, loss of appetite, lethargy
- Respiratory and cardiovascular systems: shortness of breath, cough, hemoptysis, wheeze, chest pain
- Gastrointestinal system: nausea and vomiting, hematemesis, dysphagia, heartburn, jaundice, abdominal pain, change in bowel habit, rectal bleeding, tenesmus (sensation of incomplete bowel emptying)
- Genito-urinary system: dysuria (pain on passing urine), frequency, terminal dribbling, urethral discharge
- Gynecological system: pelvic pain, vaginal bleeding, vaginal discharge, LMP
- Neurological system: headaches, dizziness, loss of consciousness, fits, faints, funny turns, numbness, tingling, weakness, problems speaking, change in vision
- Musculoskeletal system and connective tissue: joint stiffness and swelling, muscle weakness, bone fractures , sensitivity to sunlight, malaise, cold and numb fingers or toes
- Rash

Interviewing of the patient: of the Quality of Life Indexes in Endocrine Diseases



Physical examination of the patient: the main points: hands

- Oversized hands (acromegaly)
- Heat (hyperthyroid)
- Tremor (hyperthyroid)
- Palmar erythema (hyperthyroid)
- Pigmentation of palmar crease (Addison's, but normal in asians, blacks)
- 3rd, 5th metacarpals shortened (pseudohypoparathyroid)
- Pulse: rate (hyper-, hypothyroid), rhythm, character



Physical examination of the patient: the main points: arms

- Blood pressure for hypertension (Cushing'), hypotension (Addison's)
- Trousseau's sign (hypercalcemia):
 - Occlude brachial artery for 3 min using BP cuff
 - See if carpal spasm is induced
- Muscle weakness (hypothyroid, Cushing's, Conn's)



Physical examination of the patient: the main points: axillae

- Acanthosis nigricans (acromegaly)
- Axillary hair loss (hypopituitary)
- Skin tags (acromegaly)



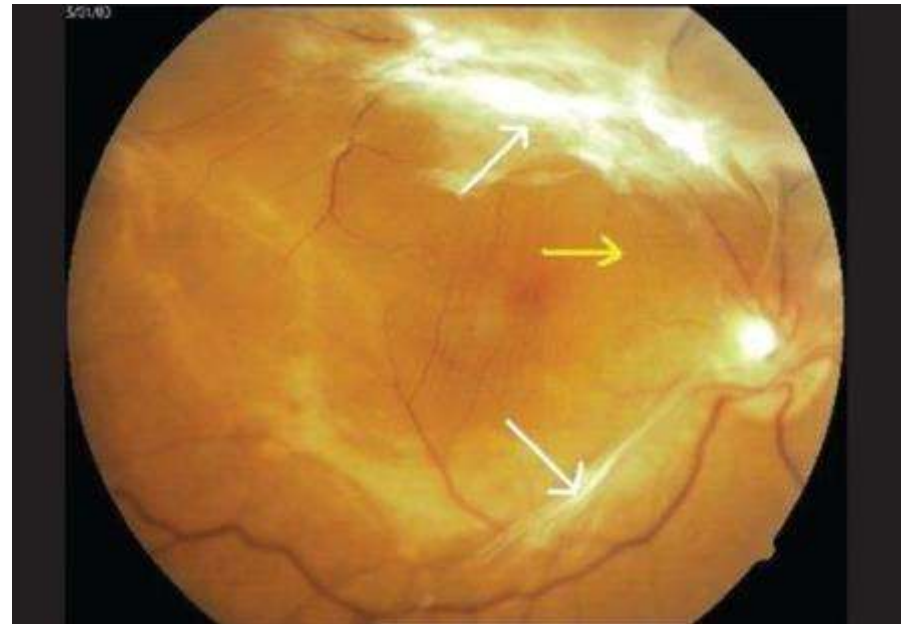
Physical examination of the patient: the main points: face

- Syndrome faces
- Acne, oily skin (Cushing's)
- Hirsutism (panhypopituitary)
- Chin enlargement (acromegaly)



Physical examination of the patient: the main points: eyes

- Exophthalmos (hyperthyroid)
- Eye fundus:
 - (diabetes mellitus)
 - (acromegaly)



diabetic retinopathy

Physical examination of the patient: the main points: mouth

- Buccal pigmentation (Addison's)
- Tongue enlargement (acromegaly)



Physical examination of the patient: the main points: neck

- Inspect buffalo hump (Cushing's)
- Palpate supraclavicular fat pads (Cushing's)
- Inspect webbed neck (Turner's)



Physical examination of the patient: the main points: thyroid

- Inspect for goiter
- Doctor palpates patient's thyroid from behind



Physical examination of the patient: the main points: chest

- Pigmented nipple (Addison's)
- Loss, gain of chest hair
- Male gynecomastia (Cushing's)
- Reduced female breast size (panhypopituitary)



Physical examination of the patient: the main points: abdomen

- Patient lies down, one pillow under head
- Purple striae (Cushing's)
- Disproportionate abdominal fat (Cushing's)



Physical examination of the patient: the main points: genitalia

- Atrophy
- Virilization



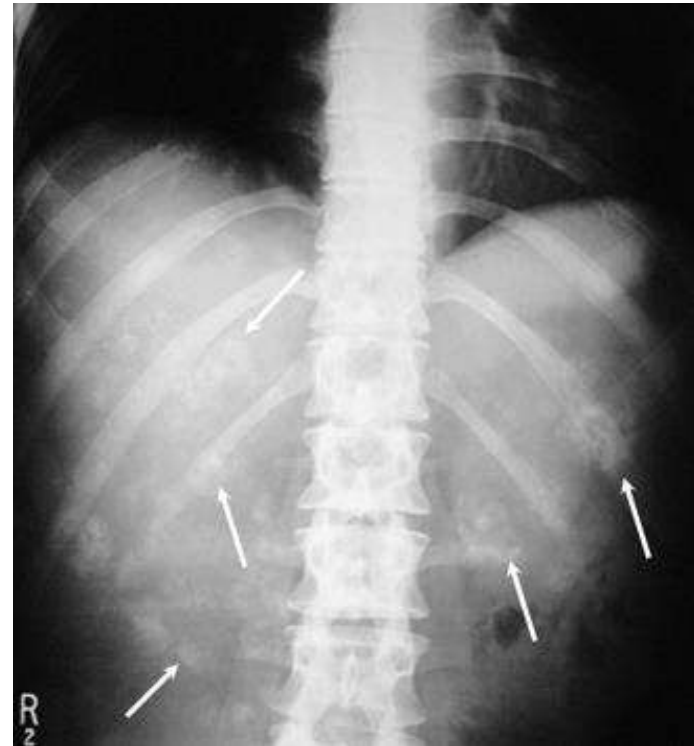
Physical examination of the patient: the main points: legs

- Peripheral neuropathy (diabetes mellitus)
- Toenails and foot showing same symptoms as Fingernails and Hands

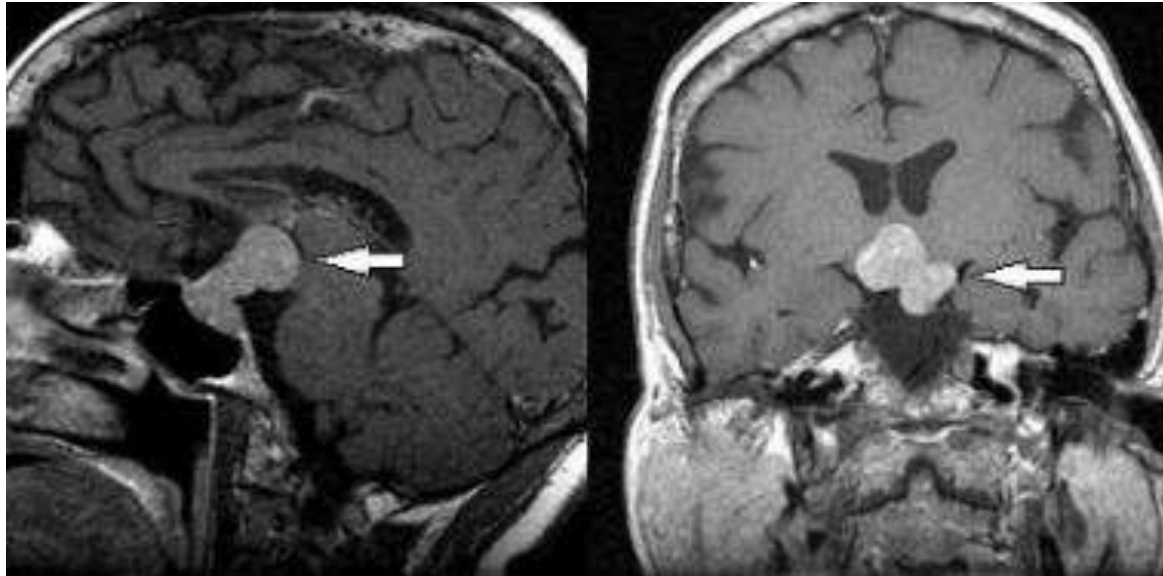


Instrumental methods: X-ray

- The radiograph reveals hepatomegaly and multiple calcifications in the upper abdomen (arrows) concerning for hepatic metastases
- The patient was ultimately found to have medullary carcinoma of the thyroid with extensive metastatic spread
- The liver is a very common location for metastatic spread from a variety of malignancies

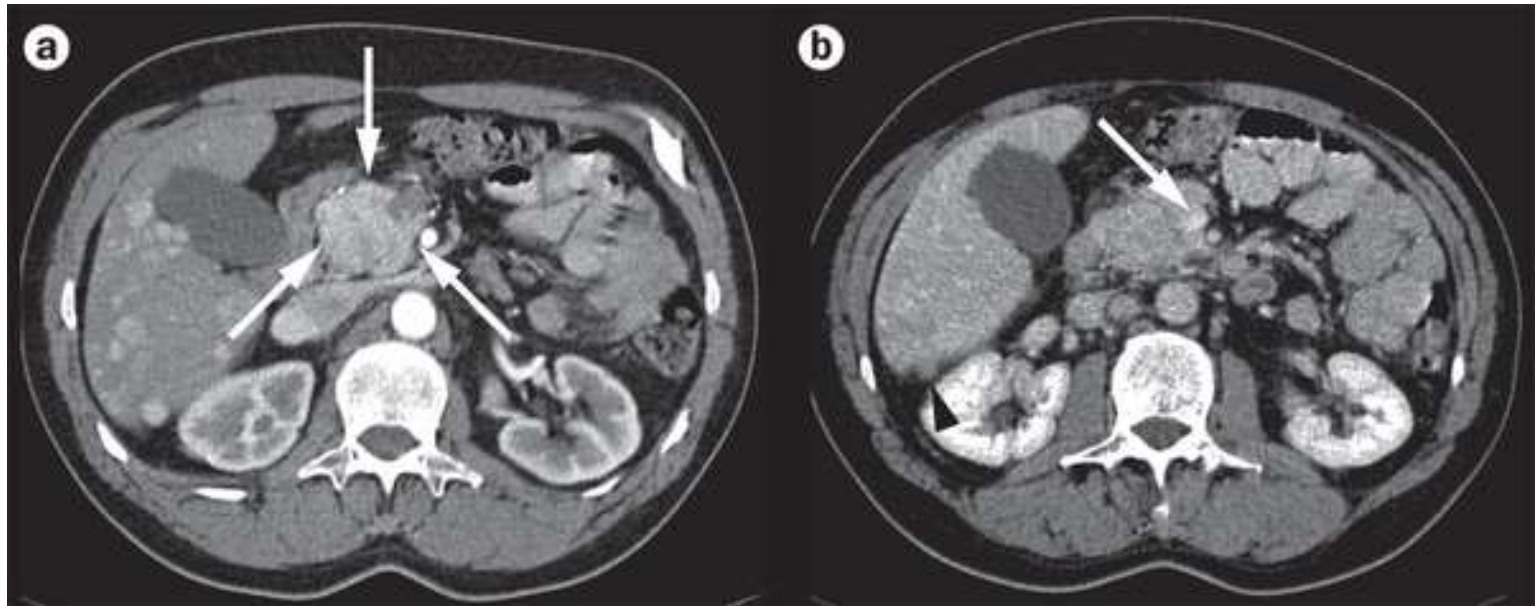


Instrumental methods: magnetic resonance imaging



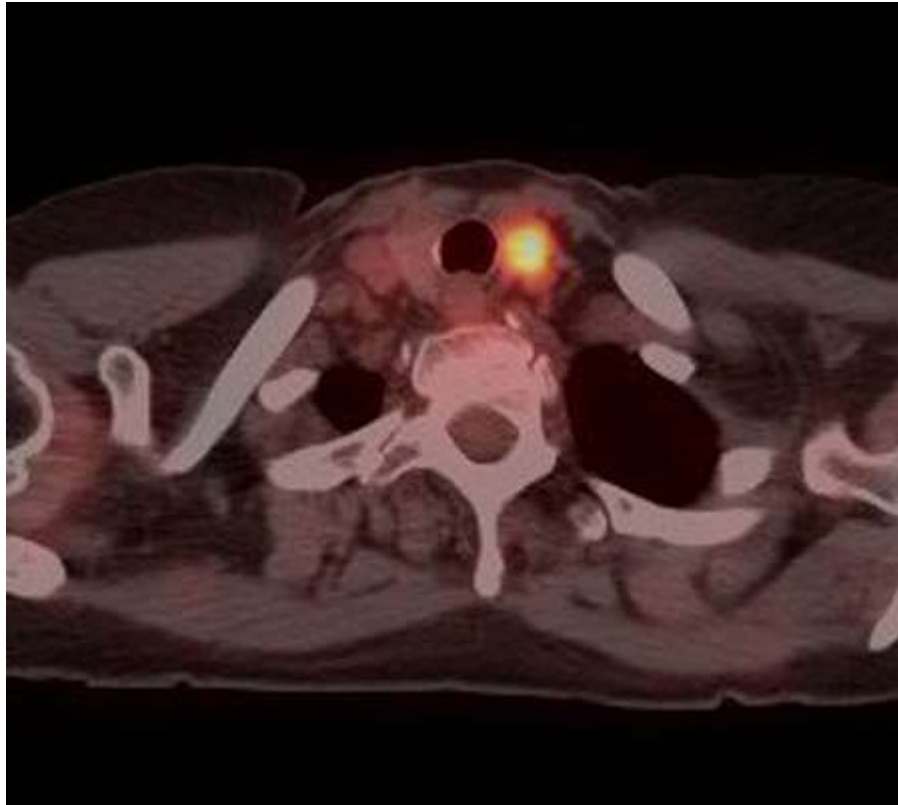
Sagittal (left image) and coronal (right image) T1-weighted magnetic resonance images of the brain in a patient with multiple endocrine neoplasia syndrome

Instrumental methods: computer tomography (CT)



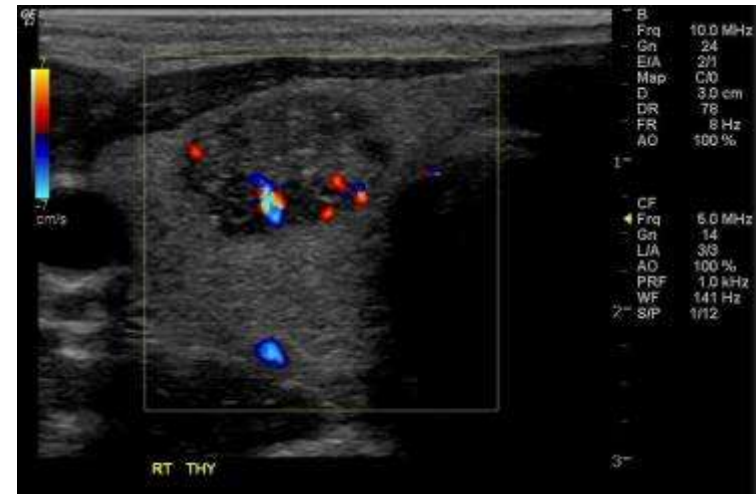
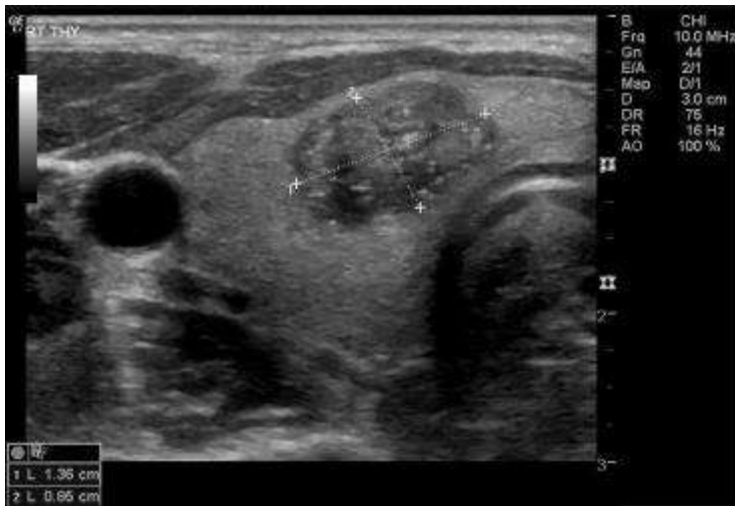
Neuroendocrine pancreatic tumor in arterial (a) and venous (b) computer tomography phases

Instrumental methods: PET/CT



Positive thyroid nodule on PET CT imaging

Instrumental methods: ultrasound



**The hyperplastic thyroid nodule, also termed a colloid
or adenomatous nodule**

Instrumental methods: ultrasound-guided biopsy



The thyroid nodule ultrasound-guided needle biopsy

Instrumental methods: neuropen screening device

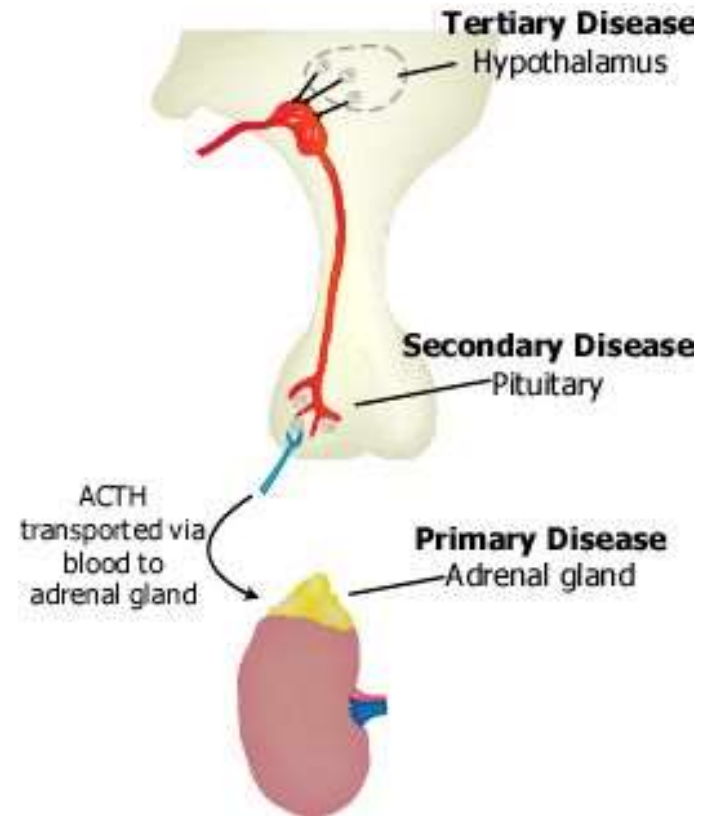
Neuropen is an effective screening aid , which combines two calibrated tests enabling the clinician to identify those patients most at risk of foot ulceration, when used in conjunction with symptomatic and clinical assessments



Laboratory methods:

Addison disease and adrenal insufficiency

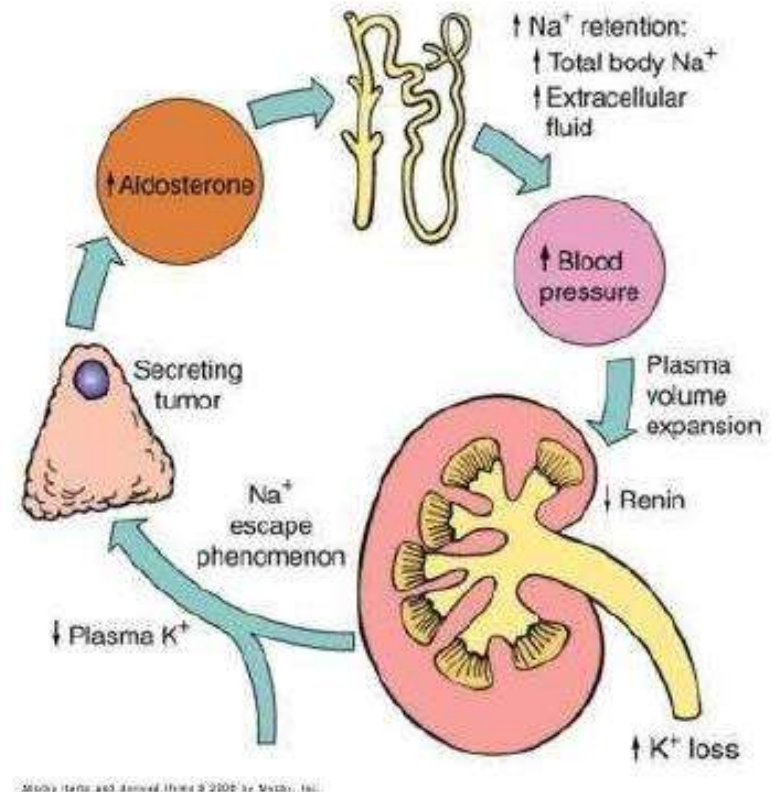
- Laboratory tests can determine if adrenal insufficiency is present, distinguish between primary and secondary insufficiencies, and help determine the underlying cause of the condition
- Tests will also be ordered to evaluate electrolyte balance, glucose level, and kidney function
- During an adrenal crisis, they are ordered to determine the severity of the imbalances and to monitor the effectiveness of treatment
- *Laboratory Tests:* Cortisol, ACTH, Creatinine (to monitor kidney function), Glucose (during an adrenal crisis)



Laboratory methods:

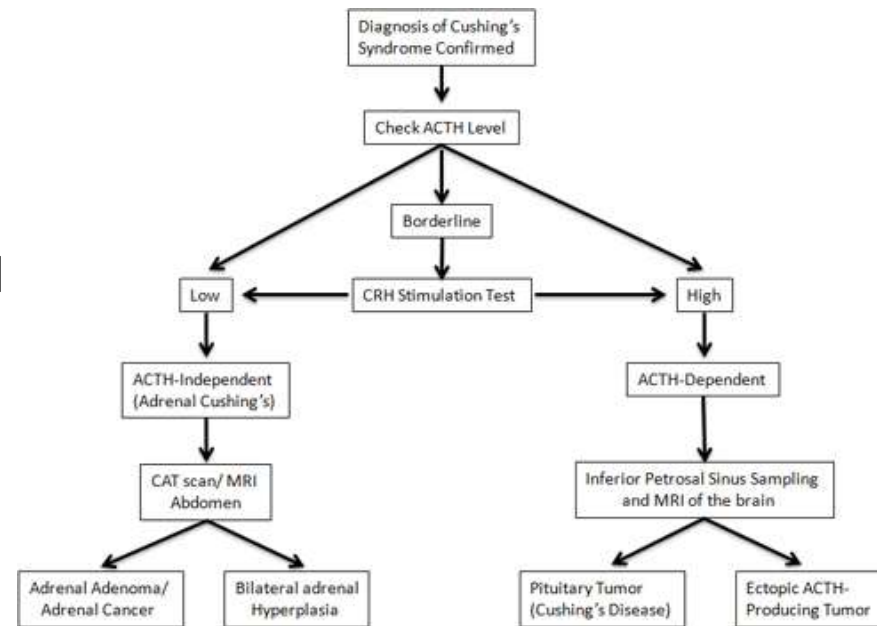
Conn's syndrome (primary hyperaldosteronism)

- The goals are to identify primary aldosteronism, distinguish between primary and secondary aldosteronism
- *Laboratory Tests:*
Electrolytes (primarily decreased potassium and chloride along with increased carbon dioxide), Blood renin tests along with blood and/or 24-hour urine aldosterone tests, The ratio of aldosterone to renin (ARR) (to test for primary aldosteronism - if renin levels are low and aldosterone levels are high, then the ratio will be significantly increased and primary aldosteronism is the likely diagnosis)



Laboratory methods: Cushing syndrome or disease

- Testing for Cushing syndrome in 2 stages:
 - Initial tests to verify that there is excess cortisol present (midnight plasma cortisol or late-night salivary cortisol, 24-hour urinary free cortisol test, the dexamethasone suppression screening test)
 - The second set of tests to determine the cause of the increased cortisol (pituitary, adrenal, or other)
- *Some general laboratory tests include:* CBC and differential (a high WBC count and increased number of neutrophils), Glucose tolerance test, Potassium



Laboratory methods: diabetes mellitus

- The goals of diabetes testing are to screen for high blood glucose levels (hyperglycemia), to detect and diagnose diabetes and prediabetes, to monitor and control glucose levels over time, and to detect and monitor complications
- Tests include:
- Fasting glucose (fasting blood glucose, FBG) – this test measures the level of glucose in the blood after an 8-12 hour fast
- A1c (also called hemoglobin A1c or glycohemoglobin) – this test evaluates the average amount of glucose in the blood over the last 2 to 3 months
- 2-hour glucose tolerance test (OGTT) – this test involves drawing a fasting blood test, followed by having a person drink a 75-gram glucose drink and then drawing another sample two hours after consuming the glucose

Instrumental methods: diabetes mellitus (glucose meter)

A medical device for determining the approximate concentration of glucose in the blood in 5 seconds



Fasting Glucose Level	Indication
From 70 to 99 mg/dL (3.9 to 5.5 mmol/L)	Normal fasting glucose
From 100 to 125 mg/dL (5.6 to 6.9 mmol/L)	Prediabetes (impaired fasting glucose)
126 mg/dL (7.0 mmol/L) and above on more than one testing occasion	Diabetes

Laboratory methods : diabetes mellitus (HbA1c analyzing)

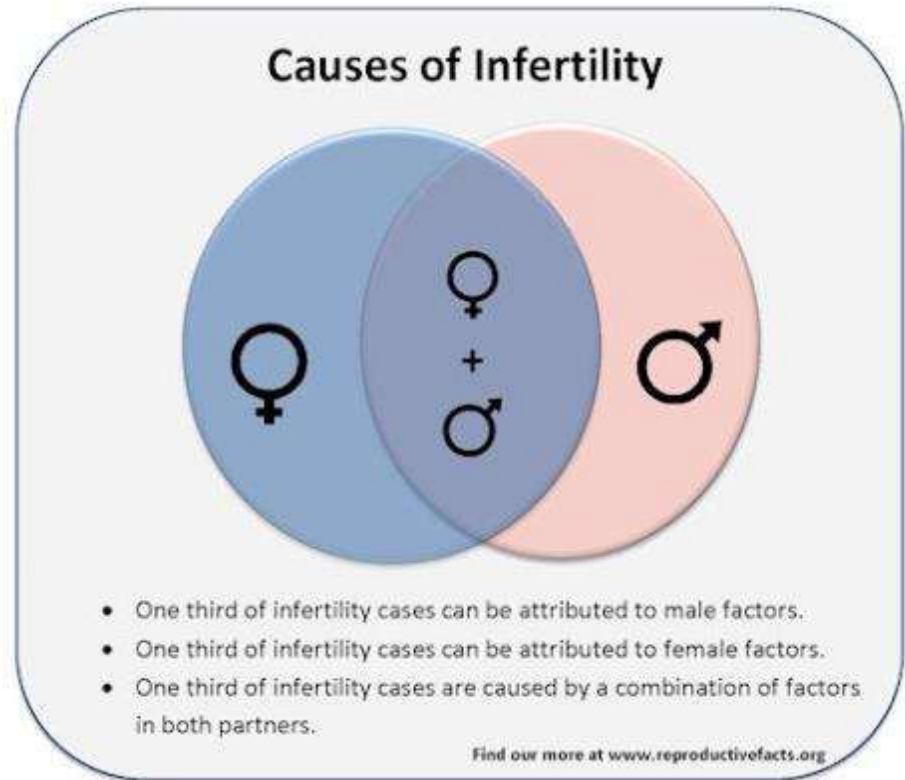
- The term HbA1c refers to glycated hemoglobin, that develops when hemoglobin, a protein within red blood cells that carries oxygen throughout your body, joins with glucose in the blood, becoming 'glycated'
- By measuring glycated hemoglobin (HbA1c), clinicians are able to get an overall picture of what patient's average blood sugar levels have been over a period of weeks/months
- HbA1c analyzers are available in several formats



A1c Level	Indication
Less than 5.7% (39 mmol/mol)	Normal
5.7% to 6.4% (39-46 mmol/mol)	Prediabetes
6.5% (47 mmol/mol) or higher	Diabetes

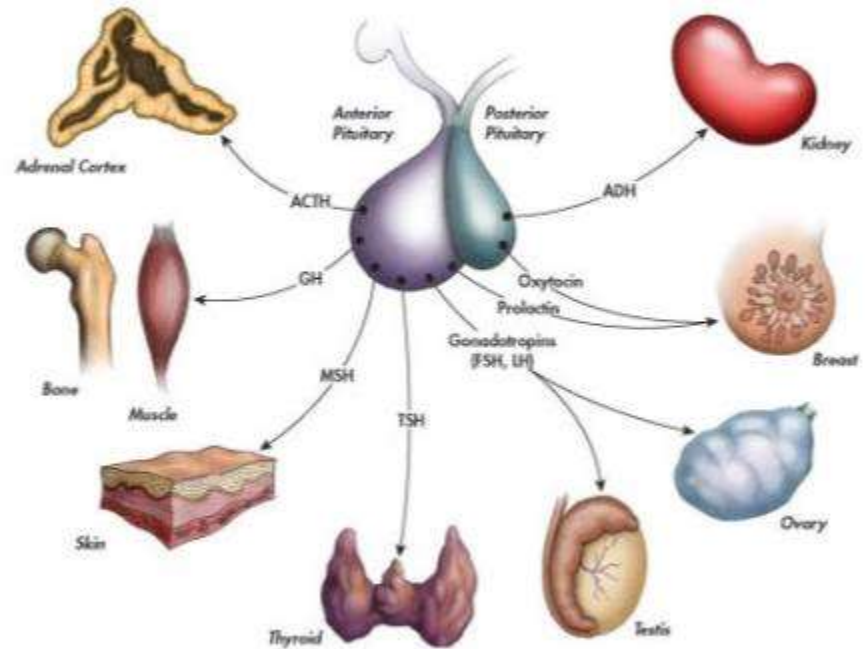
Laboratory methods: infertility

- **Tests of Female Fertility:** Luteinizing Hormone (LH), Follicle-stimulating hormone (FSH), Prolactin (PRL), Estradiol, Progesterone, Estrogen, Anti-Mullerian Hormone (AMH)
- **Tests of Male Fertility:** Free and total testosterone, Luteinizing hormone (LH), Follicle-stimulating hormone (FSH), Prolactin (PRL), Sex hormone binding globulin (SHBG), Presence of sperm antibodies



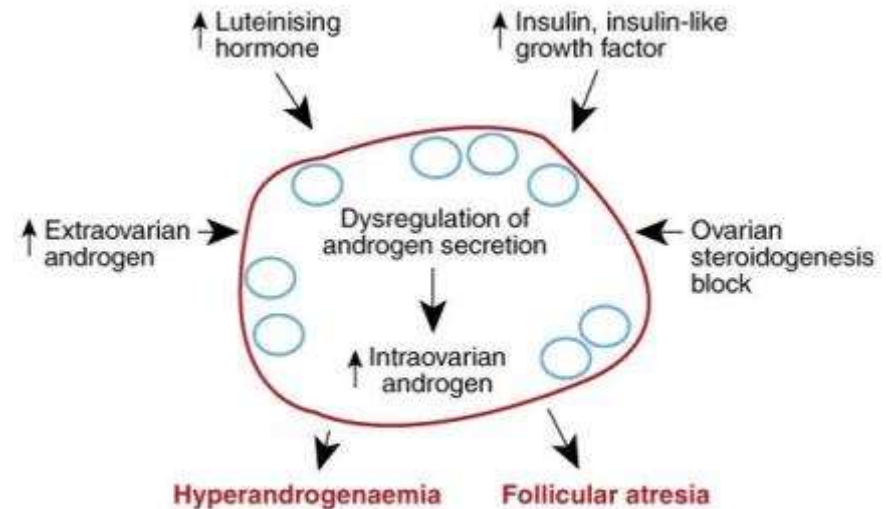
Laboratory methods: pituitary disorders

- The goals of pituitary disorder testing are to detect excess or deficient hormone production, determine its cause, and evaluate the severity of the condition
- Examples of *laboratory tests*: Prolactin, Luteinizing Hormone (LH), Follicle-stimulating hormone (FSH), Thyroid-stimulating hormone (TSH), Thyroxine, Basic metabolic panel (BMP - the current status of kidneys, electrolyte and acid/base balance, level of blood glucose), ACTH, Cortisol, growth hormone (GH) and Insulin-like Growth Factor - 1 (IGF-1), water deprivation test (to diagnose diabetes insipidus)



Laboratory methods: polycystic ovary syndrome

- There is no specific test that can be used to diagnose polycystic ovary syndrome (PCOS) and there is no widespread agreement on what the diagnostic criteria should be
- *Laboratory Tests:* Follicle stimulating hormone (FSH) – normal or low; Lutenizing hormone (LH) – elevated; Testosterone –elevated; Estrogens – normal or elevated; Sex hormone binding globulin (SBGH) –reduced, Androstenedione – elevated; Human chorionic gonadotropin (hCG) – check for pregnancy; Anti-Müllerian hormone (AMH) –increased



Laboratory methods: thyroid diseases



- The first test a health practitioner will usually order to detect thyroid dysfunction is a test for thyroid stimulating hormone (TSH): if the TSH level is abnormal, the health practitioner will usually order a test for free thyroxine (free T4) to confirm the diagnosis
- TSH – to test for hypothyroidism, hyperthyroidism, screen newborns for hypothyroidism, and monitor treatment for thyroid disorders
- Free T4 – to test for hypothyroidism, hyperthyroidism, screen newborns for hypothyroidism, and to monitor treatment of thyroid disease
- Free T3 – primarily to test for hyperthyroidism, especially when the free T4 is not elevated; when people are iodine-deficient, the thyroid makes much more T3 than T4

Lecture 11

Syndromes of respiratory system diseases

Plan of the lecture

- The importance of the respiratory system
- Reminder
 - The primary functions
 - How does the respiratory system work
 - Purpose
 - History-taking
 - Patient examination
 - Clinical
 - Laboratory
 - Instrumental
 - Imaging
 - Other tests
- Spectrum of respiratory system diseases
- Syndromes of respiratory system diseases
 - Obstructive lung syndrome (lower respiratory tract)
 - Obstructive sleep apnea (upper respiratory tract)
 - Lung consolidation syndrome
 - Respiratory failure
 - Syndromes of compression of the lungs (atelectasis, pleural effusion)
 - Acute respiratory distress syndrome
- Glossary of respiratory system pathology' terms

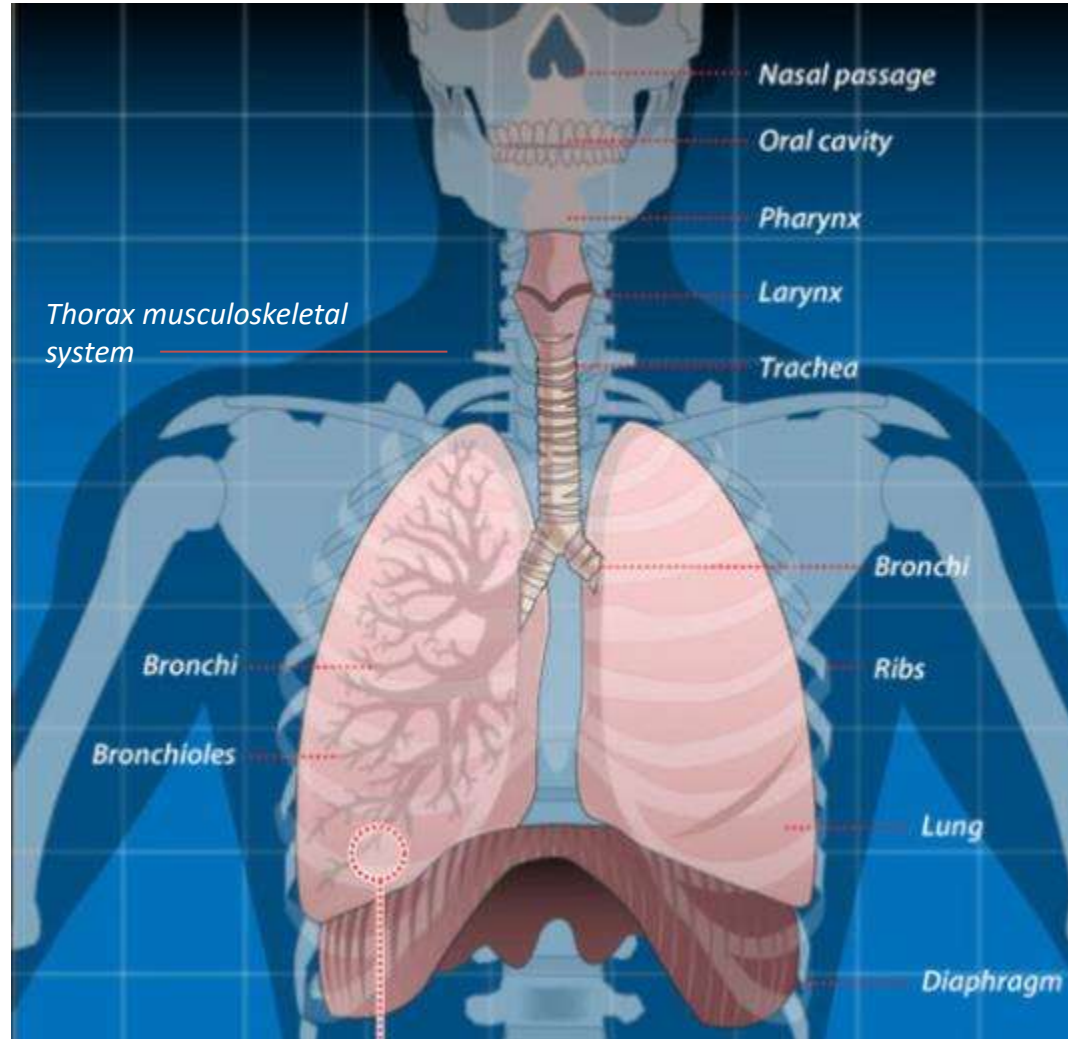
The importance of the respiratory system

- Since our childhood we all are aware that food, water and oxygen are the basic necessities of life and we cannot survive without them
- An average person can live without food for 3-4 weeks
- We cannot survive without water for more than 3-5 days
- Oxygen is crucial to sustain life, and 3 minutes is the maximum time where person can stay alive without breathing



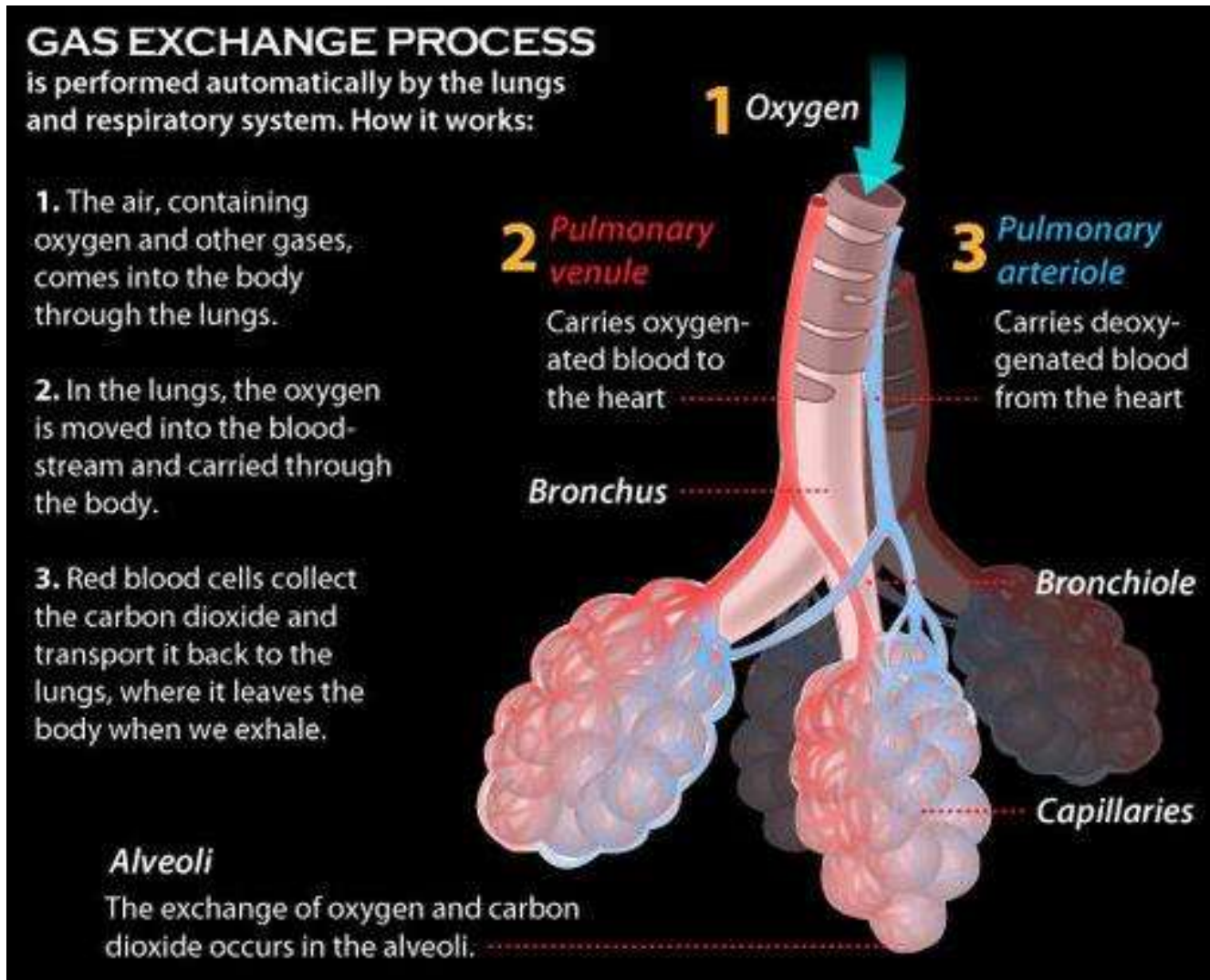
Reminder: the respiratory system functions (the primary organ)

Lower respiratory tract



Upper respiratory tract

Reminder: the respiratory system functions (gas exchange process)



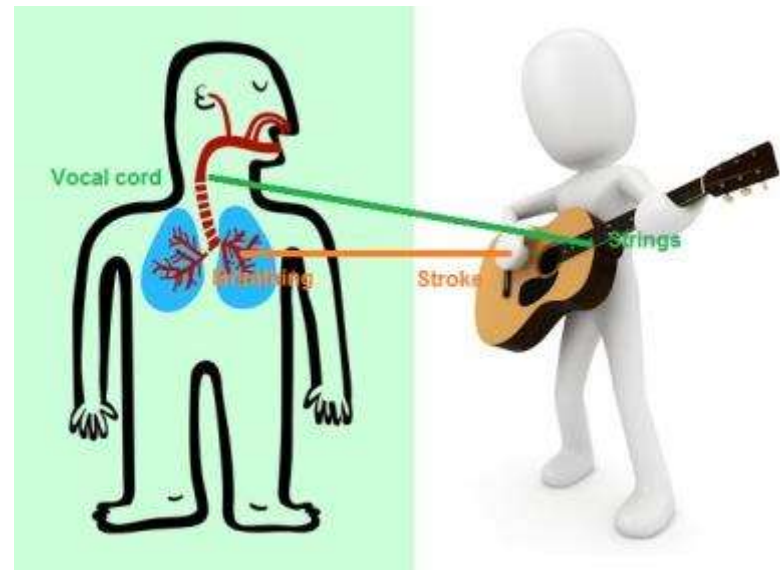
Reminder: how does the respiratory system work



<https://www.youtube.com/watch?v=qGiPZf7njqY>

Reminder: the respiratory system functions

- Gas exchange
- Immune functions
- Metabolic functions
- Endocrine functions
- Vocalization
- Temperature control
- Clearing the air (coughing and sneezing)



Reminder: purpose

- General evaluation of health
- Diagnosis of disease or disorders of the respiratory system
- Diagnosis of other systemic diseases that affect respiratory system functions
- Monitoring of patients with respiratory system diseases



History-taking (patient interviewing)

- Gathering of information
- Patient's narrative
- Biomedical perspective
- Psychosocial perspective
- Context



History-taking (patient interviewing)

- The history can often establish whether symptoms of dyspnea, chest pain, wheezing, stridor, hemoptysis, and cough are likely to be pulmonary in origin
- When more than one symptom occurs concurrently, the history should focus on which symptom is primary and whether constitutional symptoms, such as fever, weight loss, and night sweats, are also present
- Other important information includes:
 - Occupational and environmental exposures
 - Family history, travel history, and contact history
 - Previous illnesses
 - Use of prescription, OTC, or illicit drugs
 - Previous test results (e.g., tuberculin skin test, chest x-rays)



Tuberculin skin test

Patient clinical examination



Inspection



Palpation



Percussion



Auscultation

Patient clinical examination

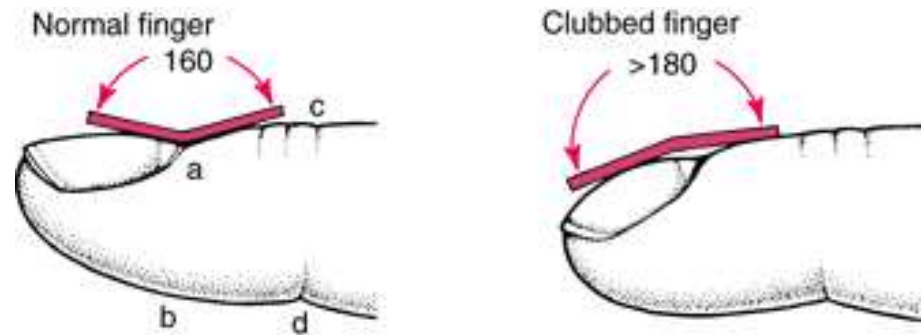
- Physical examination starts with assessment of general appearance
- Discomfort and anxiety, body habitus, and the effect of talking or movement on symptoms (e.g., inability to speak full sentences without pausing to breathe) all can be assessed while greeting the patient and taking a history and may provide useful information relevant to pulmonary status
- Next, inspection, auscultation, and chest percussion and palpation are done



Noninvasive ventilation (NIV) supports the patient's breathing without the need for intubation or a tracheotomy. NIV delivers effective therapy with less risk of infection and improved survival in patients with respiratory failure

Patient clinical examination: inspection

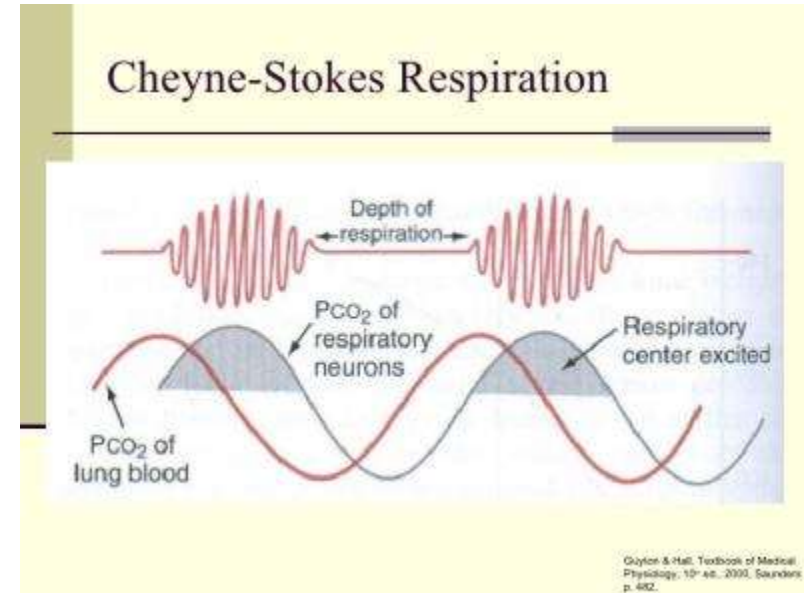
- Signs of respiratory difficulty and hypoxemia (e.g., restlessness, tachypnea, cyanosis, accessory respiratory muscle use)
- Signs of possible chronic pulmonary disease (e.g., clubbing,, pedal edema)
- Chest wall deformities
- Abnormal breathing patterns (e.g., Cheyne-Stokes respiration, Kussmaul respirations)
- Jugular venous distention



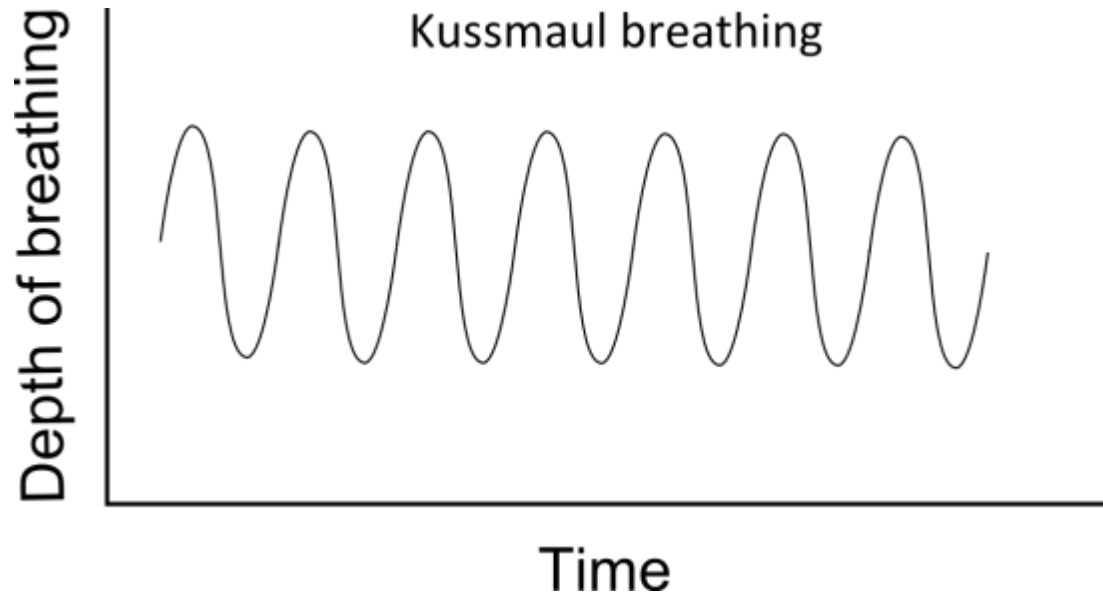
The ratio of the anteroposterior diameter of the finger at the nail bed (a–b) to that at the distal interphalangeal joint (c–d) is a simple measurement of finger clubbing. It can be obtained readily and reproducibly with calipers. If the ratio is > 1 , clubbing is present. Finger clubbing is also characterized by loss of the normal angle at the nail bed.

Patient clinical examination: Cheyne-Stokes respiration

- Cheyne-Stokes respiration (periodic breathing) is a cyclic fluctuation of respiratory rate and depth
- From periods of brief apnea, patients breathe progressively faster and deeper (hyperpnea), then slower and shallower until they become apneic and repeat the cycle
- Cheyne-Stokes respiration is most often caused by heart failure, a neurologic disorder (eg, stroke, advanced dementia), or drugs
- The pattern in heart failure has been attributed to delays in cerebral circulation; respiratory centers lag in recognition of systemic acidosis/hypoxia (causing hyperpnea) or alkalosis/hypocapnia (causing apnea)



Patient clinical examination: Kussmaul respirations



- Kussmaul respirations are deep, regular respirations caused by metabolic acidosis
- It is a form of hyperventilation, which is any breathing pattern that reduces carbon dioxide in the blood due to increased rate or depth of respiration

Patient clinical examination: jugular venous distention

- The patient is positioned under 30°, and the filling level of the external jugular vein (EJV) determined
- Pulses in the EJV are rather hard to observe, but trained cardiologists do try to discern these as signs of the state of the right atrium



Patient clinical examination: palpation and percussion

- Palpation includes tactile fremitus (vibration of the chest wall felt while a patient is speaking); it is decreased in pleural effusion and pneumothorax and increased in pulmonary consolidation (e.g., lobar pneumonias); point tenderness on palpation may signal underlying rib fracture or pleural inflammation
- Percussion is the primary physical maneuver used to detect the presence and level of pleural effusion: finding areas of dullness during percussion signifies underlying fluid or, less commonly, consolidation
- In cor pulmonale, a right ventricular impulse at the left lower sternal border may become evident and may be increased in amplitude and duration (right ventricular heave)

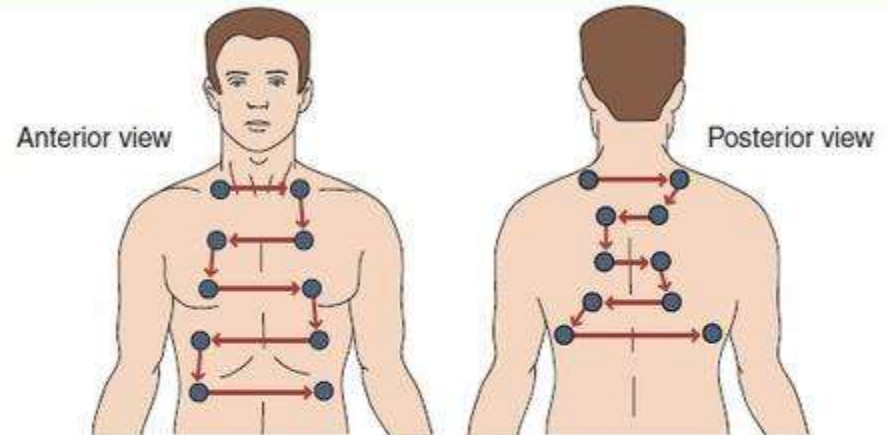


Illustration of palpation and percussion techniques. © 2008 by Elsevier Inc.

Patient clinical examination: lung auscultation

- The character and volume of breath sounds are useful in identifying pulmonary disorders
- Vesicular breath sounds are the normal sounds heard over most lung fields
- Bronchial breath sounds are slightly louder, harsher, and higher pitched; they normally can be heard over the trachea and over areas of lung consolidation, such as occur with pneumonia
- Adventitious sounds are abnormal sounds, such as crackles, rhonchi, wheezes, and stridor

Order of Auscultating Lung Sounds



Respiratory Patterns

Normal (eupnea)	Regular and comfortable at 12–20 breaths/minute.
Tachypnea	>20 breaths/minute.
Bradypnea	<12 breaths/minute.
Hyperventilation	Rapid, deep respiration >20 breaths/minute.
Apneustic	Neurological—sustained inspiratory effort.
Cheyenne-Stokes	Neurological—alternating patterns of depth separated by brief periods of apnea.
Kussmaul's	Rapid, deep, and labored—common in DKA.
Air trapping	Difficulty during expiration— emphysema.

Patient clinical examination

adventitious lung auscultation sounds

- Crackles (rales) are discontinuous adventitious breath sounds and occur most commonly with atelectasis, alveolar filling processes (e.g., pulmonary edema), and interstitial lung disease (e.g., pulmonary fibrosis); they signify opening of collapsed alveoli
- Rhonchi are low-pitched respiratory sounds that can be heard during inspiration or expiration and occur in various conditions, including chronic bronchitis; the mechanism may relate to variations in obstruction
- Wheezes are whistling, musical breath sounds that are worse during expiration than inspiration; they are associated with dyspnea
- Stridor is a high-pitched, predominantly inspiratory sound formed by extrathoracic upper airway obstruction and can be heard without a stethoscope
- Decreased breath sounds signify poor air movement in airways, as occurs with asthma and COPD where bronchospasm or other mechanisms limit airflow; they may also be decreased in the presence of a pleural effusion, pneumothorax, or obstructing endobronchial lesion

Patient clinical examination: vocal sounds

Vocal sounds involve auscultation while patients vocalize:

- Bronchophony and whispered pectoriloquy occur when the patient's spoken or whispered voice is clearly transmitted through the chest wall; voice transmission results from alveolar consolidation, as occurs with pneumonia
- Egophony (E to A change) is said to occur when, during auscultation, a patient says the letter "E" and the examiner hears the letter "A," again as occurs with pneumonia



Patient clinical examination: findings of common disorders

Disorder	Pleural Effusion	Consolidation	Emphysema	Pneumothorax	Mucous Plug (With Collapse)
<i>Examination finding</i>					
<i>Tracheal deviation</i>	Contralateral	None	None	Contralateral	Ipsilateral
<i>Fremitus</i>	Decreased	Increased	Decreased	Decreased	Decreased
<i>Percussion</i>	Dull	Dull	Hyper-resonant	Hyper-resonant	Dull
<i>Pectoriloquy</i>	Decreased	Increased	Decreased	Decreased	Decreased
<i>Breath sounds</i>	Decreased	Decreased	Crackles	Decreased	Decreased

Patient laboratory examination: basic tests

- Blood gases (blood pH, oxygen and carbon dioxide)
- Complete blood count (CBC) – to evaluate blood cells and check for inflammation
- Comprehensive metabolic panel (CMP) – to evaluate organ function, chemical and electrolyte balances

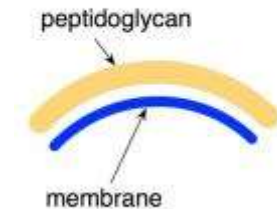
Made by: W. Chase Allen SSA

Hgb (Hemoglobin) Males = 13.8 - 17.2 Females = 12.1 - 15.1		
WBC (White Blood Cells) 4,500 - 10,000		Plts (Platelets) 150 - 400
Hct (Hematocrit) Males = 40.7 - 50.3% Females = 36.1 - 44.3%		
Na (Sodium) 135 - 145	Cl (Chloride) 100 - 108	BUN (Blood Urea Nitrogen) Males = 8 - 24 Females = 6 - 21
K (Potassium) 3.6 - 5.2	HCO₃ (Bicarbonate) 22 - 29	Crt (Creatinine) Males = 0.8 - 1.3 Females = 0.6 - 1.1
Glucose 70 - 100		

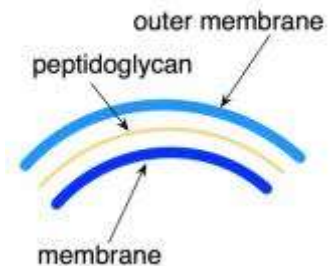
Patient laboratory examination: additional tests

- Cystic fibrosis tests (CF gene mutation testing , Sweat chloride, Immunoreactive trypsin (IRT), Stool trypsin)
- Alpha-1 antitrypsin
- Pleural fluid analysis
- Allergy tests (asthma triggers)
- Tests for pneumonia or other specific infections (Bacterial sputum culture and Gram stain)
- Influenza tests
- Respiratory syncytial virus (RSV)
- Tests for autoantibodies: anti-nuclear antibody (ANA), extractable nuclear antigen (ENA) panel, anti-ds DNA
- Sputum cytology

GRAM-POSITIVE



GRAM-NEGATIVE



Patient instrumental examination

- Spirometry (to evaluate narrowed or obstructed airways)
- Oximetry (measures the oxygen saturation of the blood)
- Exercise stress test on a stationary bike or treadmill
- Air flow with a peak flow meter (measures the rate of exhalation at home)
- Lung volume (the quantity of air a person takes into their lungs and how much is left in the lungs after exhalation)
- Diffusing capacity measurement (the transfer of oxygen from the lung air sacs to the bloodstream)



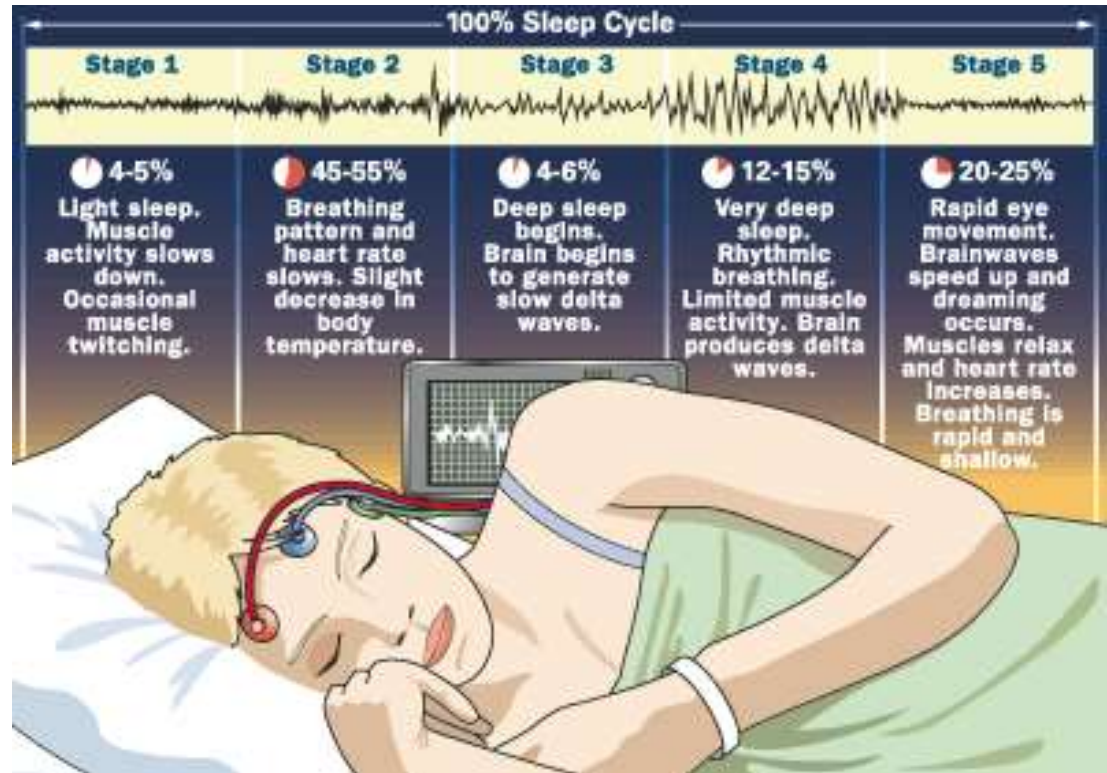
Patient instrumental examination: imaging tests

- Chest x-ray – to look at lung structure and chest cavity
- CT (computed tomography) scan – a more detailed evaluation of lung structure
- MRI (Magnetic resonance imaging) – detailed pictures of organs and vessels in the chest
- Ultrasound – used to detect fluid between the pleural membranes
- Nuclear lung scanning – used to help detect pulmonary embolism and, rarely, to evaluate the effectiveness of lung cancer treatment
- Positron emission tomography (PET) scans – used to help diagnose lung cancer



Patient instrumental examination: other tests

- Electrocardiogram (EKG, ECG) – to look at heart rhythm, to determine if heart disease may be affecting breathing
- Sleep studies – usually performed at special sleep centers to help determine whether a person is breathing normally during sleep



Spectrum of the respiratory system diseases

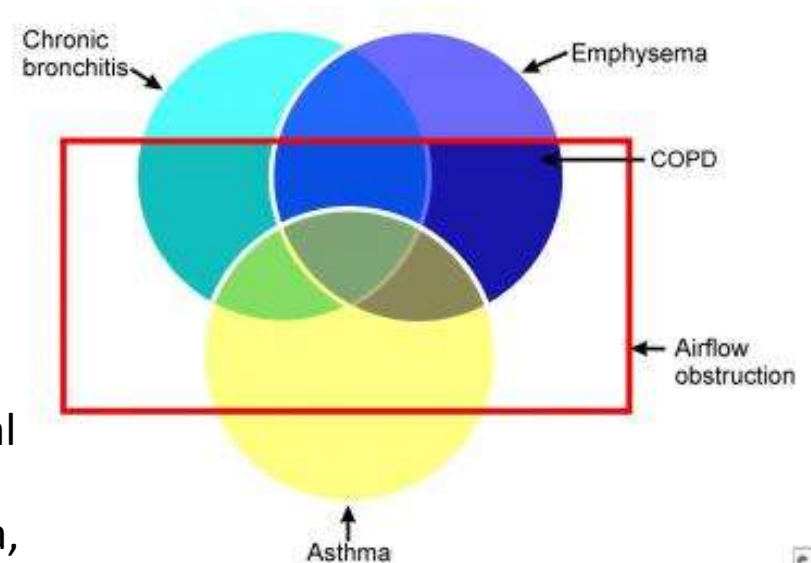
- Obstructive conditions (e.g., emphysema, bronchitis, asthma attacks)
- Restrictive conditions (e.g., fibrosis, sarcoidosis, alveolar damage, pleural effusion)
- Vascular diseases (e.g., pulmonary edema, pulmonary embolism, pulmonary hypertension)
- Infectious, environmental and other "diseases" (e.g., pneumonia, tuberculosis, asbestosis, particulate pollutants)

The respiratory tract is constantly exposed to microbes due to the extensive surface area, which is why the respiratory system includes many mechanisms to defend itself and prevent pathogens from entering the body



Obstructive lung syndrome: definition, diseases

- Obstructive syndrome is characterized by airway obstruction
- Many obstructive diseases of the lung result from narrowing of the smaller bronchi and larger bronchioles, often because of excessive contraction of the smooth muscle itself
- Obstructive syndrome is generally characterized by inflamed and easily collapsible airways, obstruction to airflow, problems with exhaling and frequent medical clinic visits and hospitalizations
- Obstructive syndrome lays in basis of asthma, bronchiectasis, bronchitis, chronic obstructive pulmonary disease (COPD), cystic fibrosis , etc.

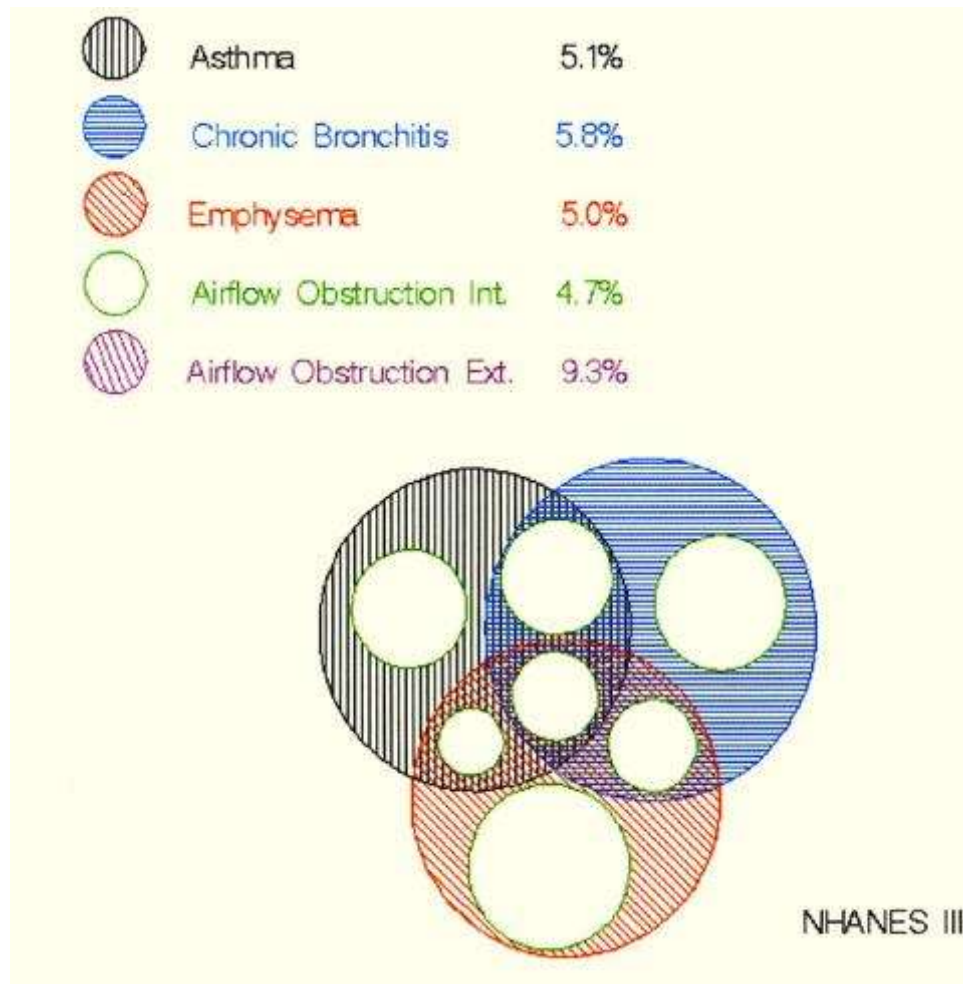


Obstructive lung syndrome: accent on causes

- Smoking including passive smoking (Chronic Obstructive Pulmonary Disease (COPD))
- Frequent chest infections, particularly in winter
- Serious asthma symptoms with frequent exacerbations for a long time, which have not been improving with treatment
- Long-term exposure to lung irritants (air pollution (industrial dust , chemical fumes, etc.))
- Preterm birth that leads to lung damage (neonatal chronic lung disease).
- A family history of emphysema
- Inherited factors (genes), including alpha-1 antitrypsin deficiency



Obstructive lung syndrome (OLS): proportional Venn diagram of OLS in the United States (NHANES III surveys from 1988 to 1994)



Obstructive lung syndrome: symptoms

- Shortness of breath (in early stages occurs only with exertion)
- Tightness in chest
- Cough (dry or productive of white or colored sputum)
- A flare-up (an exacerbation), often worse in winter with wheezing
- Depression and anxiety
- Weight loss
- Tiredness and fatigue
- Swollen ankles
- Limitations in activity and lifestyle

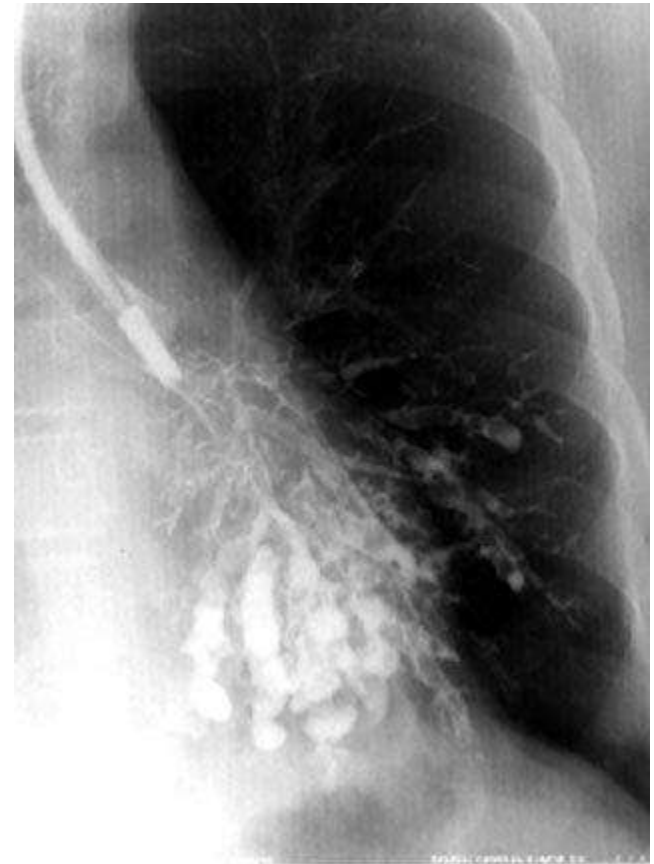


Obstructive lung syndrome: conditions and nature

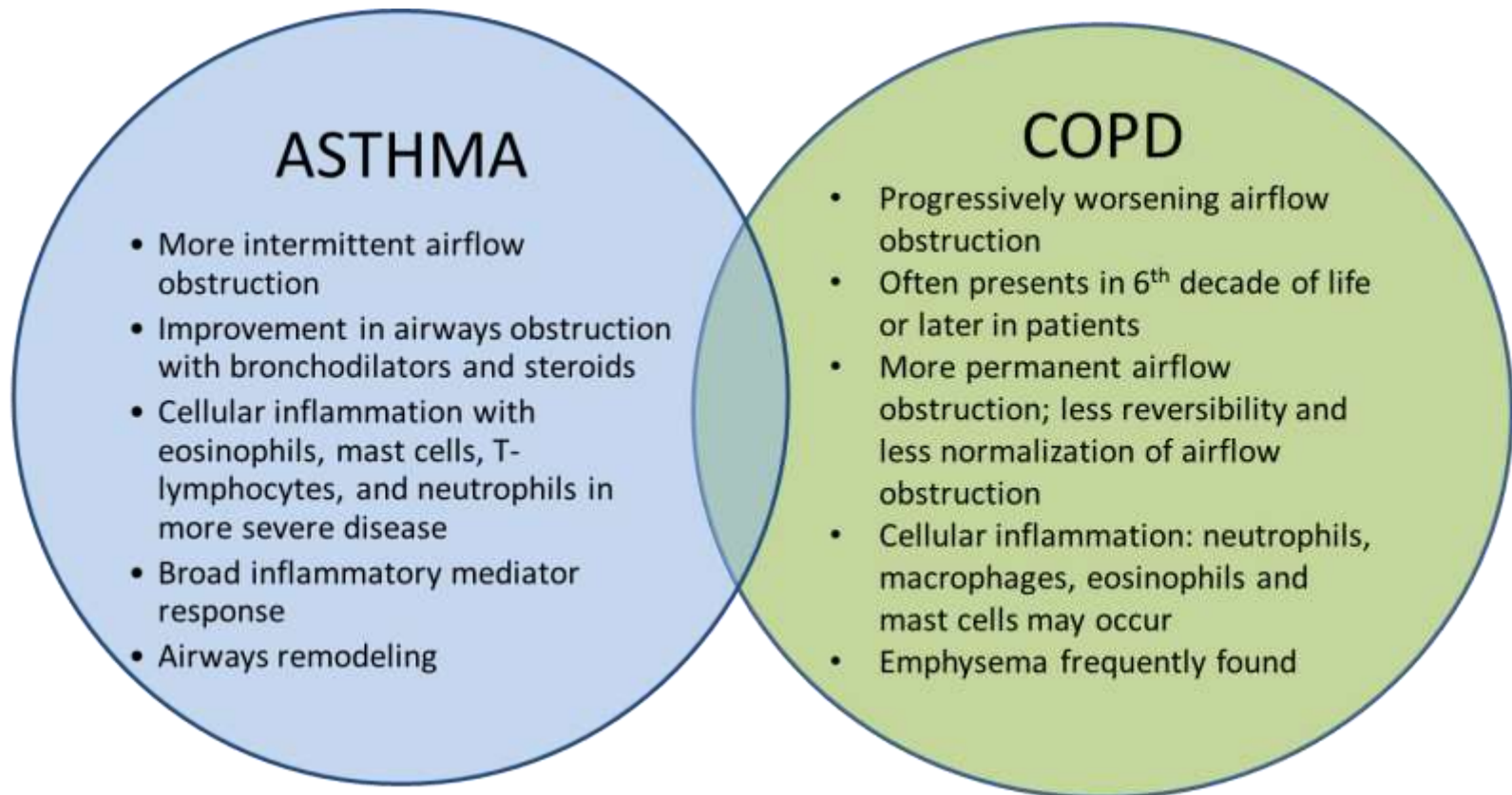
Condition	Main site	Major changes	Causes	Symptoms
Chronic bronchitis	Bronchus	Hyperplasia and hypersecretion of mucus glands	Tobacco smoking and air pollutants	Productive cough
Bronchiectasis	Bronchus	Dilation and scarring of airways	Persistent severe infections	Cough, purulent sputum and fever
Asthma	Bronchus	Smooth muscle hyperplasia, excessive mucus, inflammation, constriction	Immunologic or idiopathic	Episodic wheezing, cough and dyspnea
Bronchiolitis (subgroup of chronic bronchitis)	Bronchiole	Inflammatory scarring and bronchiole obliteration	Tobacco smoking and air pollutants	Cough, dyspnea

Obstructive lung syndrome: spot the difference

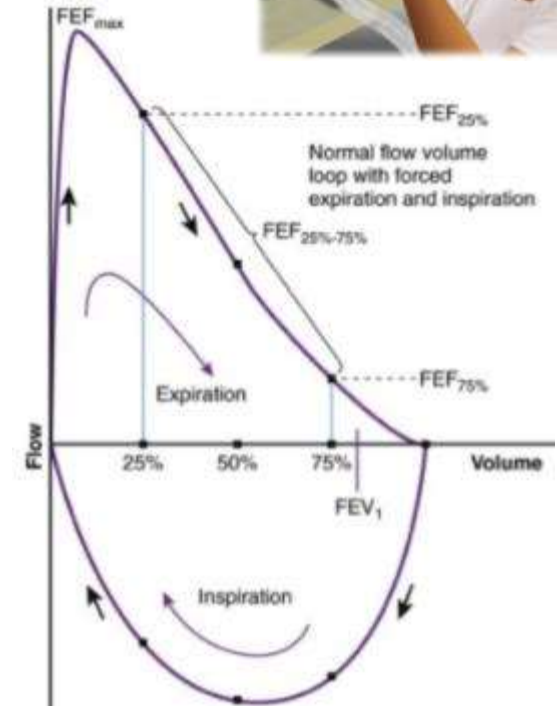
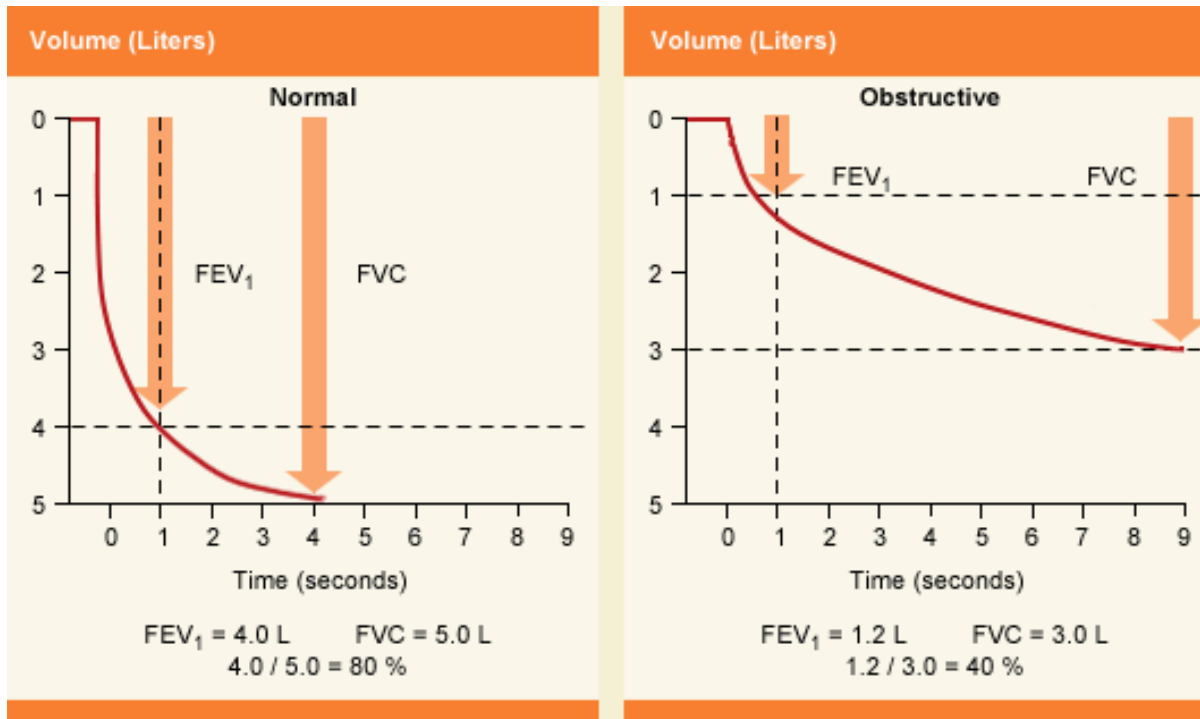
- In asthma the bronchial tubes (airways) are hyperresponsive and usually triggered by breathing in things in the air such as dust, pollen, etc. with recurring episodes of wheezing, breathlessness, chest tightness, and coughing, particularly at night or in the early morning
- Bronchiectasis refers to the abnormal, irreversible dilatation of the bronchi caused by destructive and inflammatory changes in the airway walls
- Chronic obstructive pulmonary disease (COPD) is characterized by airflow limitation that is not fully reversible



Obstructive lung syndrome: spot the difference



Obstructive lung syndrome: lung function tests



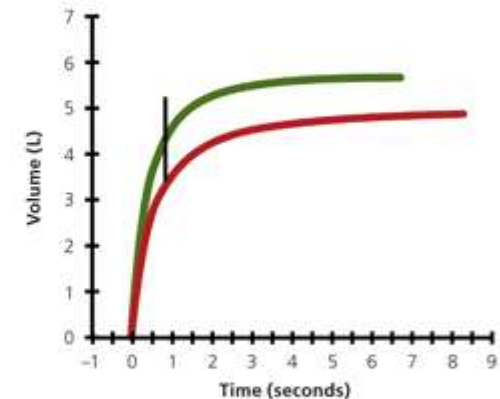
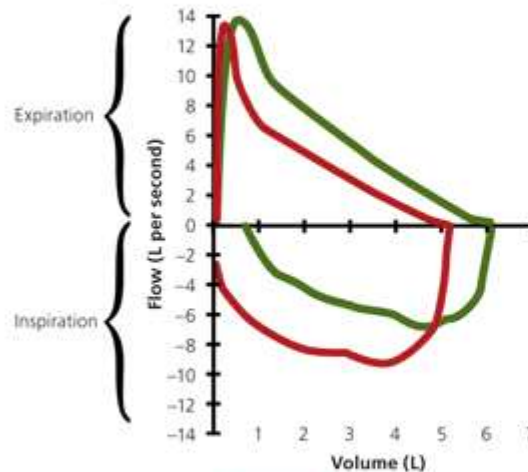
FVC = forced vital capacity, FEV₁ = forced expiratory volume in the first second of expiration

Obstructive lung syndrome: lung function tests

The obstructive defect is reversible because at least one of the two measurements (FVC or FEV_1) increased by at least 0.2 L and by at least 12%. ($FEF_{25\%-75\%}$ = forced expiratory flow at 25% to 75% of FVC; FEV_1 = forced expiratory volume in one second; FVC = forced vital capacity; LLN = lower limit of normal)

Age: 26 years Height: 5 ft, 8 in Weight: 197 lb Sex: Male Race: Hispanic

Spirometry	Prebronchodilators				Postbronchodilators		
	Predicted	LLN	Actual	% of predicted	Actual	% of predicted	% change
FVC (L)	5.20	4.34	5.18 ^A	99 ^D	6.06 ^F	116	+16 ^I
FEV_1 (L)	4.37	3.64	3.55 ^B	81 ^E	4.64 ^H	106	+30 ^J
FEV_1/FVC (%)	84	75	68 ^C	81	77 ^G	91	+11
$FEF_{25\%-75\%}$ (L per second)	4.74	3.11	2.41	50	3.84	80	+59



— Before bronchodilator use — After bronchodilator use

A = FVC (before bronchodilators), this is > LLN and thus does not show a restrictive pattern
 B = FEV_1 (before bronchodilators)
 C = FEV_1/FVC ratio (before bronchodilators), this is < LLN and thus shows an obstructive defect
 D = FVC percentage of predicted (before bronchodilators)
 E = FEV_1 percentage of predicted (before bronchodilators)
 F = FVC (after bronchodilators)

G = FEV_1 (after bronchodilators)
 H = FEV_1/FVC ratio (after bronchodilators)
 I = A 0.88-L increase in FVC is a 16% increase
 J = A 1.09-L increase in FEV_1 is a 30% increase

The above indicates reversibility because at least one of the two (FVC or FEV_1) increased by at least 0.2 L and by at least 12%

Obstructive lung syndrome: lung function tests

Classification of COPD by impairment of lung function

	COPD stage	Spirometry (postbronchodilator)
GOLD 1	Mild	FEV ₁ ≥80% predicted FEV ₁ /FVC <0.7
GOLD 2	Moderate	50% ≤ FEV ₁ < 80% predicted FEV ₁ /FVC <0.7
GOLD 3	Severe	30% ≤ FEV ₁ < 50% predicted FEV ₁ /FVC <0.7
GOLD 4	Very severe	FEV ₁ <30% predicted FEV ₁ /FVC <0.7

FEV₁: Forced expiratory volume in 1 second; **FVC:** Forced vital capacity; **GOLD:** Global Initiative for Chronic Obstructive Lung Disease

Classification of COPD severity should be undertaken with care in patients with comorbid diseases or other possible contributors to shortness of breath

Postbronchodilator forced expiratory volume in 1 s (FEV₁) to forced vital capacity (FVC) ratio less than 0.7 is required for the diagnosis of COPD to be established

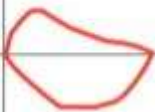

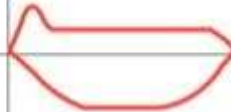


Reference: Modified from GOLD Global strategies for the diagnosis, management, and prevention of chronic obstructive pulmonary disease updated 2014

Obstructive lung syndrome: spirometric measures in asthma, COPD and ACOS

Spirometric variable	Asthma	COPD	ACOS
Normal FEV ₁ /FVC pre- or post BD	Compatible with diagnosis	Not compatible with diagnosis	Not compatible unless other evidence of chronic airflow limitation
Post-BD FEV ₁ /FVC <0.7	Indicates airflow limitation but may improve spontaneously or on treatment	Required for diagnosis (GOLD)	Usually present
FEV ₁ ≥80% predicted	Compatible with diagnosis (good asthma control or interval between symptoms)	Compatible with GOLD classification of mild airflow limitation (categories A or B) if post- BD FEV ₁ /FVC <0.7	Compatible with diagnosis of mild ACOS
FEV ₁ <80% predicted	Compatible with diagnosis. Risk factor for asthma exacerbations	An indicator of severity of airflow limitation and risk of future events (e.g. mortality and COPD exacerbations)	An indicator of severity of airflow limitation and risk of future events (e.g. mortality and exacerbations)
Post-BD increase in FEV ₁ >12% and 200 ml from baseline (reversible airflow limitation)	Usual at some time in course of asthma, but may not be present when well-controlled or on controllers	Common and more likely when FEV ₁ is low, but ACOS should also be considered	Common and more likely when FEV ₁ is low, but ACOS should also be considered
Post-BD increase in FEV ₁ >12% and 400ml from baseline (marked reversibility)	High probability of asthma	Unusual in COPD. Consider ACOS	Compatible with diagnosis of ACOS

ACOS: asthma-COPD overlap syndrome; BD: bronchodilator; FEV₁: forced expiratory volume in 1 second; FVC: forced vital capacity; GOLD: Global Initiative for Obstructive Lung Disease.

Obstructive lung syndrome: lung function tests

	Small airway obstruction		Upper airway obstruction		
	COPD	Asthma attack	Variable intrathoracic	Variable extrathoracic	Fixed
FVC	N to ↓	↓	N	N	N
FEV ₁	↓	↓	↓	N	↓
FEV ₁ /FVC	↓	N to ↓	↓	N	↓
Flow-volume loop					

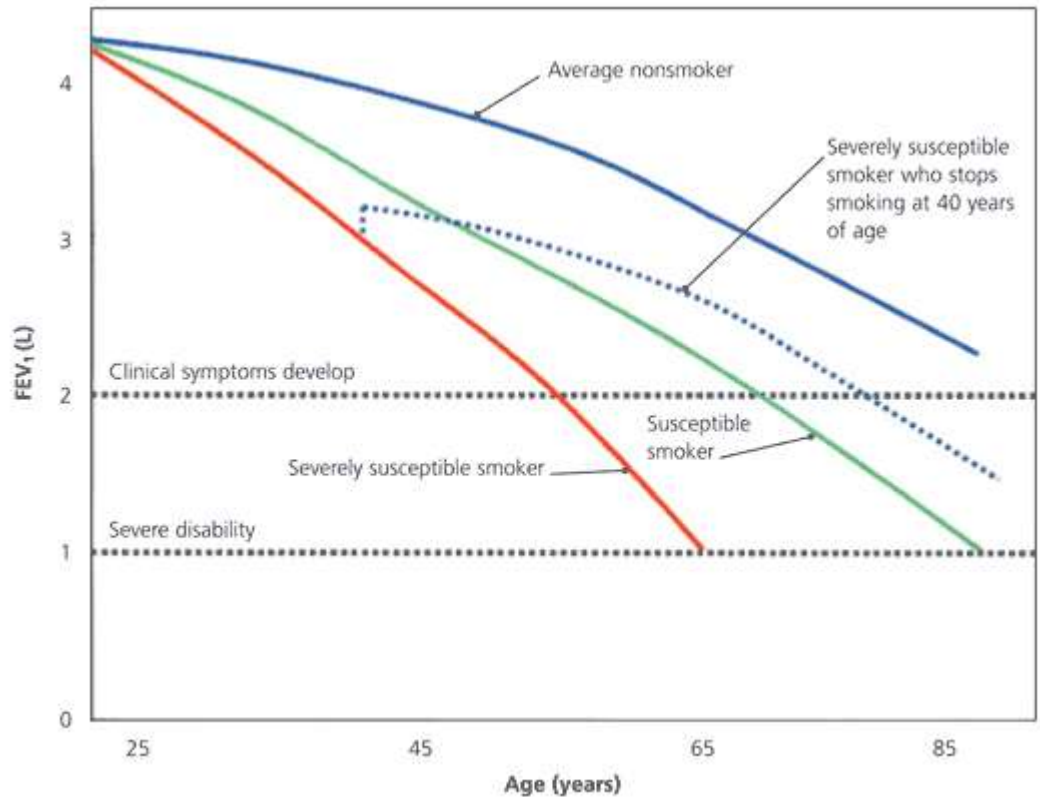
Typical findings of pulmonary function tests in patients with small (lower) airway and upper airway obstruction. COPD = chronic obstructive pulmonary disease, FVC = forced vital capacity, FEV₁ = forced expiratory volume in the first second of expiration

Obstructive lung syndrome: lung function decline in smokers and nonsmokers

Smokers who are susceptible to lung injury experience an increase in the rate of age-related loss in FEV_1 compared with nonsmokers (red, green, and blue lines)

After lung function declines to threshold levels, clinical symptoms develop (black dotted lines)

When a smoker stops smoking, the rate of FEV_1 loss again approximates to that of a nonsmoker (blue dotted line)



FEV_1 = forced expiratory volume in one second

Obstructive lung syndrome: chest X-ray

- A chest X-ray may show signs of obstructive lung syndromes and can be used to help exclude other serious conditions (including lung cancer)
- The X-ray may show:
 - Flattening of the diaphragm, the large muscle that separates the lungs and heart from the abdominal cavity
 - Increased size of the chest, as measured from front to back
 - A long narrow heart
 - Abnormal air collections within the lung (focal bullae)
- A normal chest X-ray does not mean patient do not have COPD



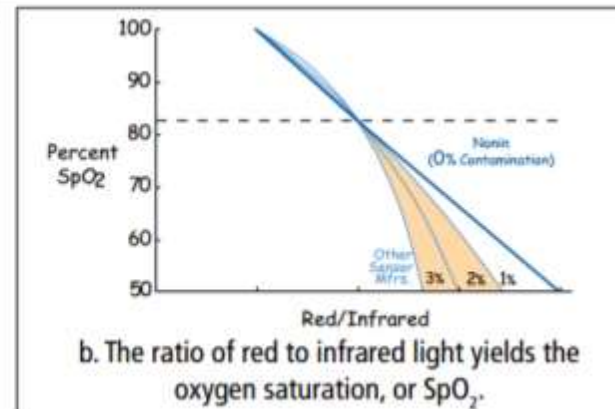
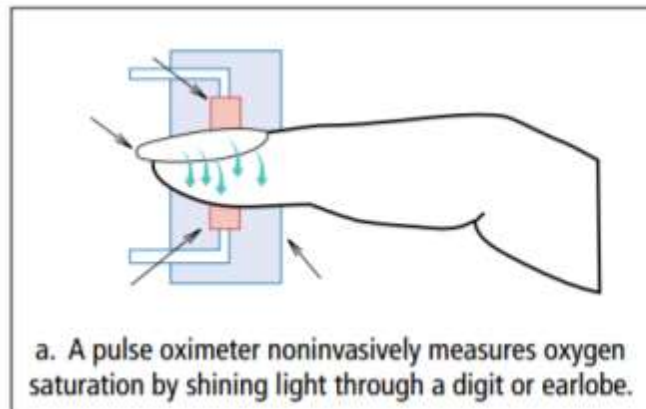
The X-ray demonstrates a pneumothorax on the left side in which a chest tube was placed for reexpansion. On the right side the patient has multiple large apical bullae which are also at risk of rupture.

Obstructive lung syndrome: arterial blood gas test

pH result	Bicarbonate result	PaCO ₂ result	Condition	Common causes
Less than 7.35	Low	Low	Metabolic acidosis	Kidney failure, shock, diabetic ketoacidosis, intoxication with methanol, salicyate , ethanol
Greater than 7.45	High	High	Metabolic alkalosis	Chronic vomiting, low blood potassium , heart failure , cirrhosis
Less than 7.35	High	High	Respiratory acidosis	Narcotics, lung diseases such as asthma , COPD, airway obstruction
Greater than 7.45	Low	Low	Respiratory alkalosis	Hyperventilation, pain, anxiety, brain trauma, pneumonia, certain drugs (salicylate, catecholamines)

- Arterial blood gas analysis is used to measure the pH and the partial pressures of oxygen and carbon dioxide in arterial blood
- Interpretation of an arterial blood gas result should not be done without considering the clinical findings
- Factors relating to sampling technique, specimen processing and environment may also influence the results

Obstructive lung syndrome: oximetry



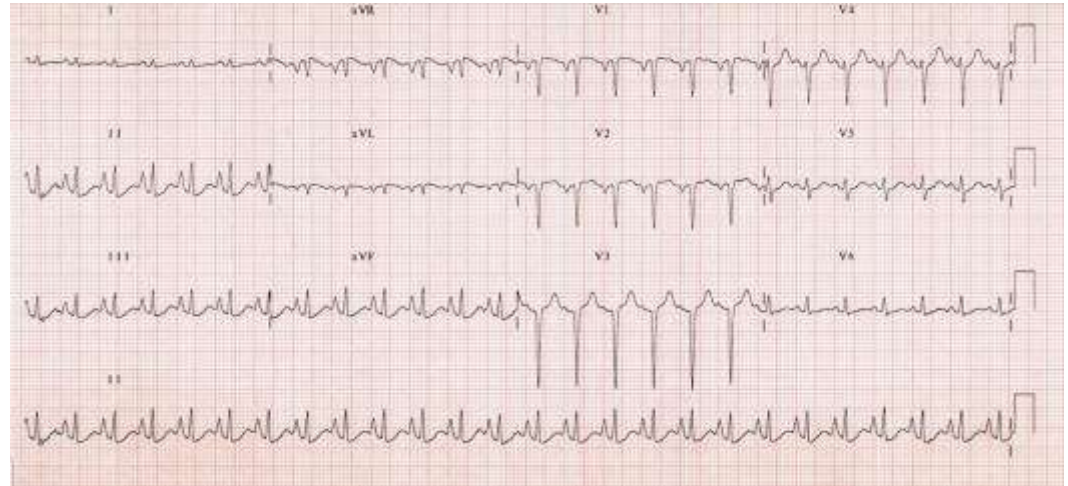
- o An SpO_2 of greater than 95% is generally considered to be normal.
- o An SpO_2 of 92% or less (at sea level) suggests hypoxemia.
 - In a patient with acute respiratory illness (e.g., influenza) or breathing difficulty (e.g., an asthma attack), an SpO_2 of 92% or less may indicate a need for oxygen supplementation.
 - In a patient with stable chronic disease (e.g., COPD), an SpO_2 of 92% or less should prompt referral for further investigation of the need for long-term oxygen therapy [5, 6].

- The test measures the oxygen saturation in the blood
- The test can be useful in finding out whether oxygen treatment is needed, but it provides less information than the arterial blood gas test

Obstructive lung syndrome: electrocardiogram

ECG changes occur in obstructive lung syndromes due to:

- The presence of hyperexpanded emphysematous lungs within the chest
- The long-term effects of hypoxic pulmonary vasoconstriction upon the right side of the heart, causing pulmonary hypertension and subsequent right atrial and right ventricular hypertrophy (i.e. cor pulmonale)



The ECG demonstrates many of the features of chronic pulmonary disease:

Rightward QRS axis (+90 degrees)

Peaked P waves in the inferior leads > 2.5 mm (P pulmonale) with a rightward P-wave axis (inverted in aVL)

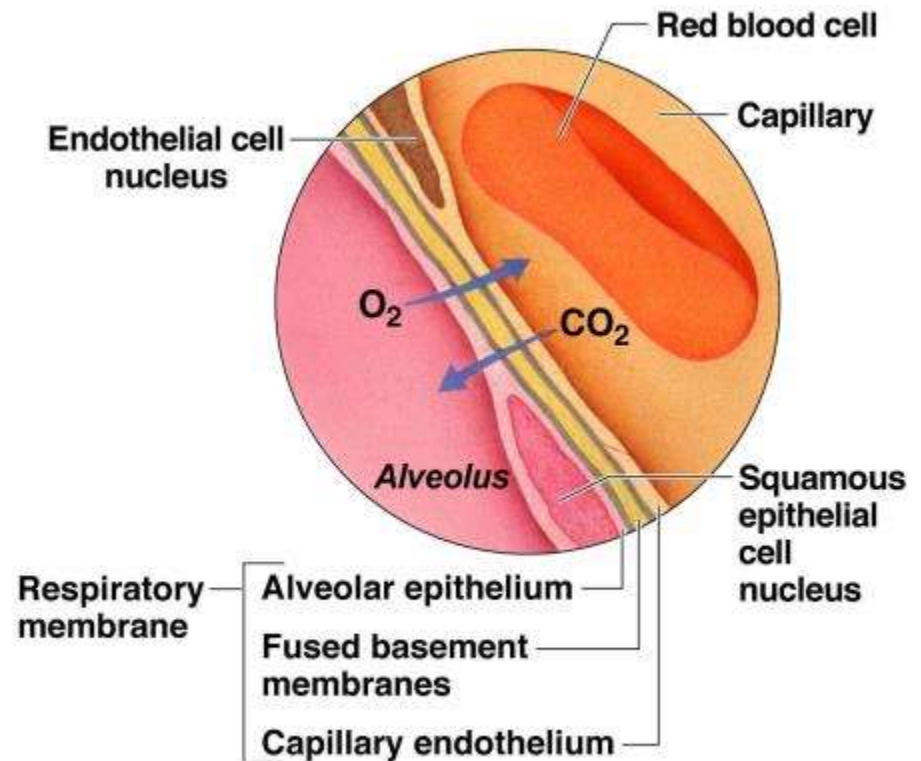
Clockwise rotation of the heart with a delayed R/S transition point (transitional lead = V5)

Absent R waves in the right precordial leads (SV1-SV2-SV3 pattern)

Low voltages in the left-sided leads (I, aVL, V5-6)

Obstructive lung syndrome: transfer factor for carbon monoxide

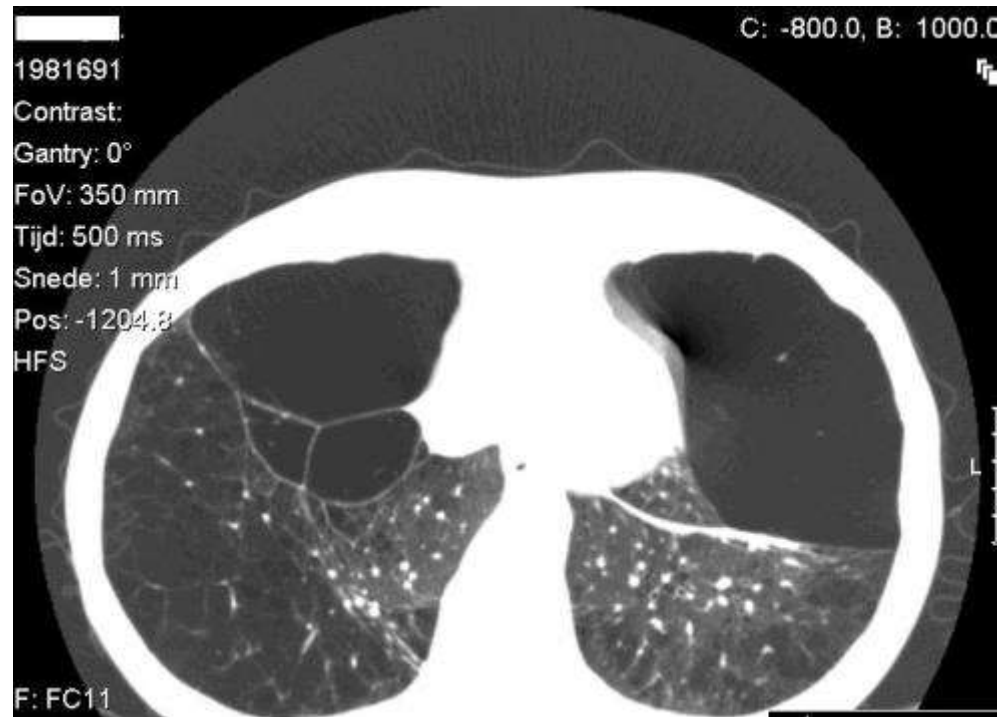
- D_{LCO} or T_{LCO} (diffusing capacity or transfer factor of the lung for carbon monoxide (CO),) is the extent to which oxygen passes from the air sacs of the lungs into the blood
- The test looks at whether lungs have been damaged, and if so, how much damage there is



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Obstructive lung syndrome: tests rarely done

- Alpha-1 antitrypsin (AAT) test for recognizing emphysema
- A CT scan for detailed picture of the lungs



Computed tomography of the lung showing emphysema and bullae in the lower lung lobes of a subject with type ZZ alpha-1-antitrypsin deficiency

Obstructive lung syndrome: specialized investigations sometimes used in distinguishing asthma and COPD

	Asthma	COPD
Inflammatory biomarkers		
Test for atopy (specific IgE and/or skin prick tests)	Modestly increases probability of asthma; not essential for diagnosis	Conforms to background prevalence; does not rule out COPD
FENO	A high level (>50 ppb) in non-smokers supports a diagnosis of eosinophilic airway inflammation	Usually normal. Low in current smokers.
Blood eosinophilia	Supports asthma diagnosis	May be present during exacerbations
Sputum inflammatory cell analysis	Role in differential diagnosis is not established in large populations	

Obstructive lung syndrome: regular checkups

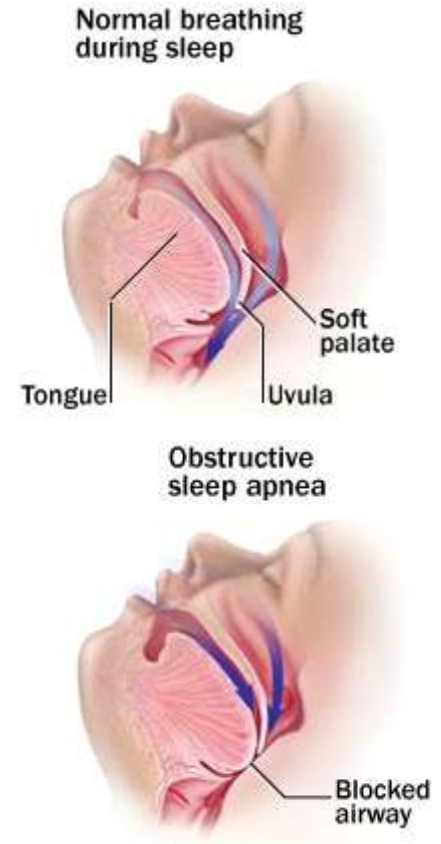
- Spirometry
- Arterial blood gas test
- X-rays or ECGs



**I quit smoking 30 years ago,
not soon enough, I have COPD**

Obstructive sleep apnea: definition, causes

- Obstructive sleep apnea (OSA) is caused by obstruction of the upper airway
- OSA is characterized by repetitive pauses (apneas) in breathing during sleep, which typically last 20 to 40 seconds despite the effort to breathe.
- OSA is usually associated with a reduction in blood oxygen saturation
- OSA is commonly accompanied with snoring
- The main causes of OSA are old age, temporary or permanent brain injury, decreased muscle tone, excess soft tissue around the airway (common with obese patients), something physical in the throat or mouth/jaw shape



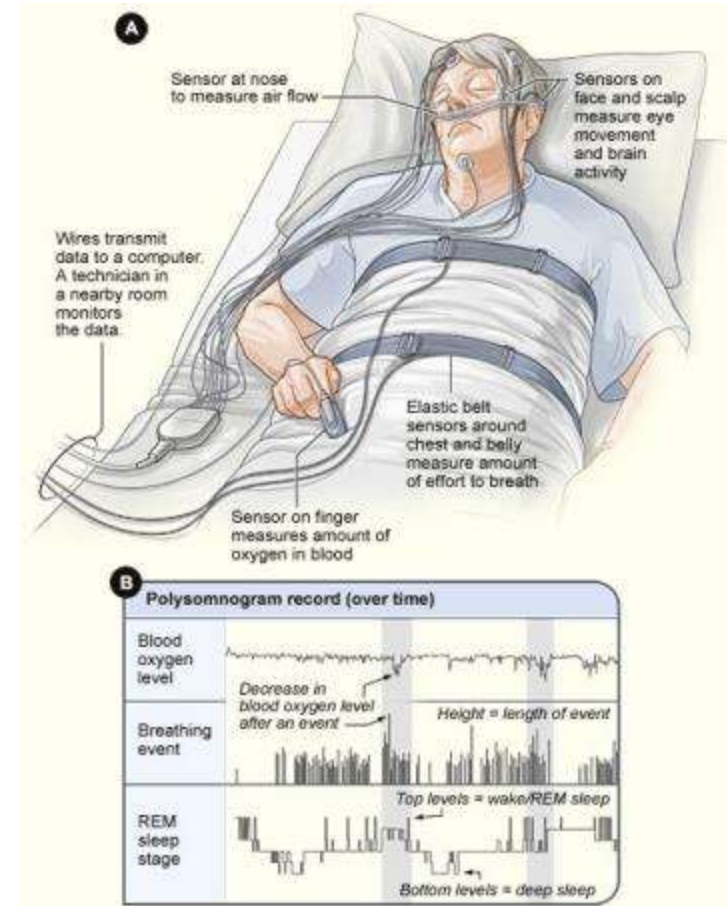
Obstructive sleep apnea: symptoms

- Excessive daytime sleepiness
- Loud snoring
- Episodes of breathing cessation in sleep
- Abrupt awakenings by shortness of breath
- Awakening with a dry mouth or sore throat
- Awakening with chest pain
- Morning headache
- Difficulty concentrating during the day
- Experiencing mood changes
- Difficulty staying asleep
- High blood pressure



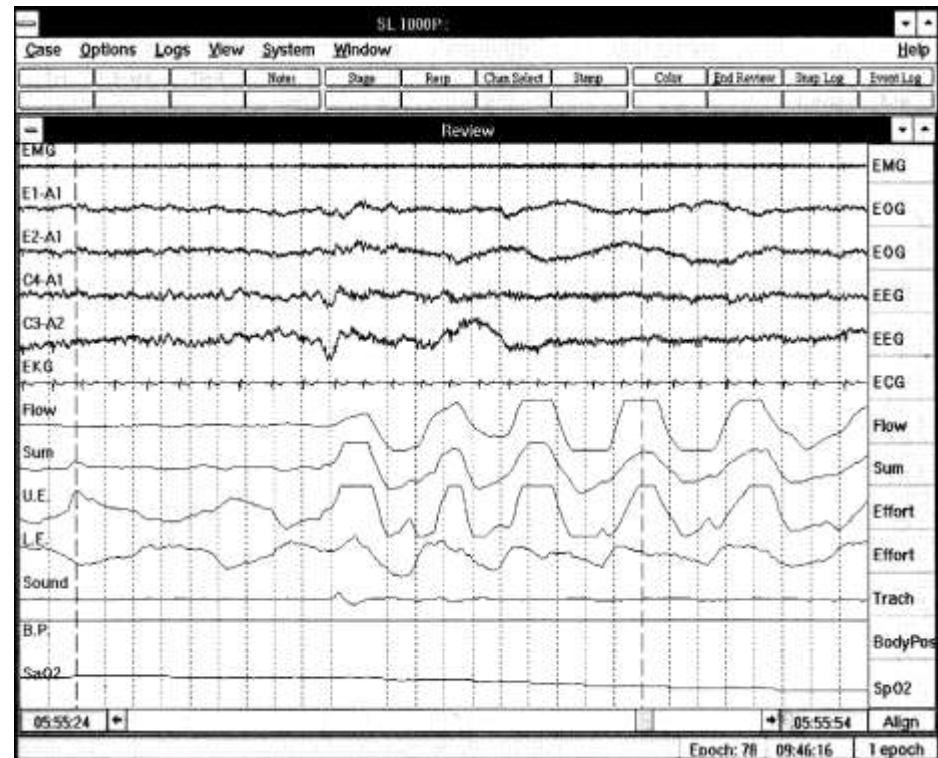
Obstructive sleep apnea: diagnosis

- Nocturnal polysomnography - records brain wave changes, eye movements, leg movements, blood oxygen levels, muscle tone, heart rhythms and respiration during sleep
- Oximetry
- Epworth sleepiness scale - to measure the patient's level of daytime sleepiness
- The three ratings for OSA:
 - Mild - 5-14 episodes of apnea or hypopnea per hour
 - Moderate - 15 to 30 episodes of apnea or hypopnea per hour
 - Severe - over 30 episodes of apnea or hypopnea per hour



Obstructive sleep apnea: nocturnal polysomnography

- 30-second epoch of a polysomnographic recording in the 13 channels muscular tension (EMG), eye movements (EOG), bioelectrical brain function (EEG), heart rate (ECG), breathing (flow, sum, upper and lower effort), snoring (Trach), body position (BodyPos) and oxygen saturation (SPO2) are recorded
- During the first 10 seconds an obstructive apnea (cessation of breathing) is clearly visible as a flat line in the flow channel



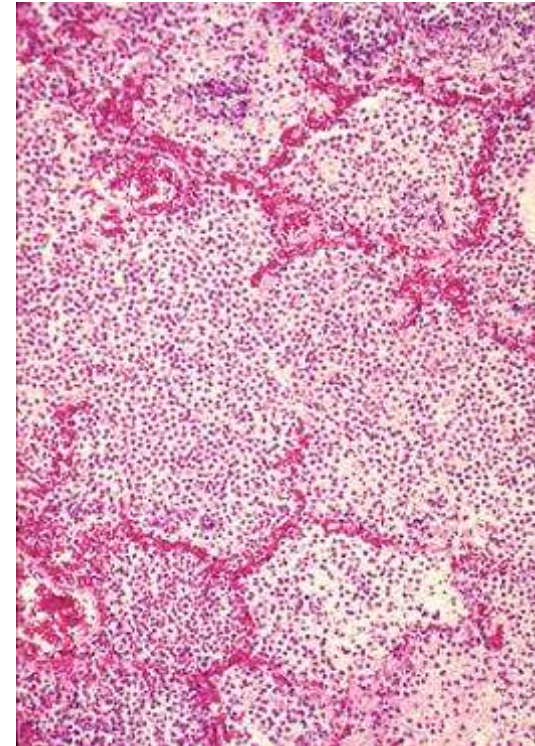
Obstructive sleep apnea:

Epworth sleepiness scale' questions

Situations	0. Would never fall asleep	1. Slight chance of fall asleep	2. Moderate chance of fall asleep	3. High chance of fall asleep
Sitting and reading				
Watching TV				
Sitting inactive in a public place				
As a passenger in a car for an hour without a break				
Lying down to rest in the afternoon when circumstances permit				
Sitting and talking to someone				
Sitting quietly after lunch without alcohol				
In a car, whilst stopped for a few minutes in traffic				
Sex				
Age				

Lung consolidation syndrome: definition and causes

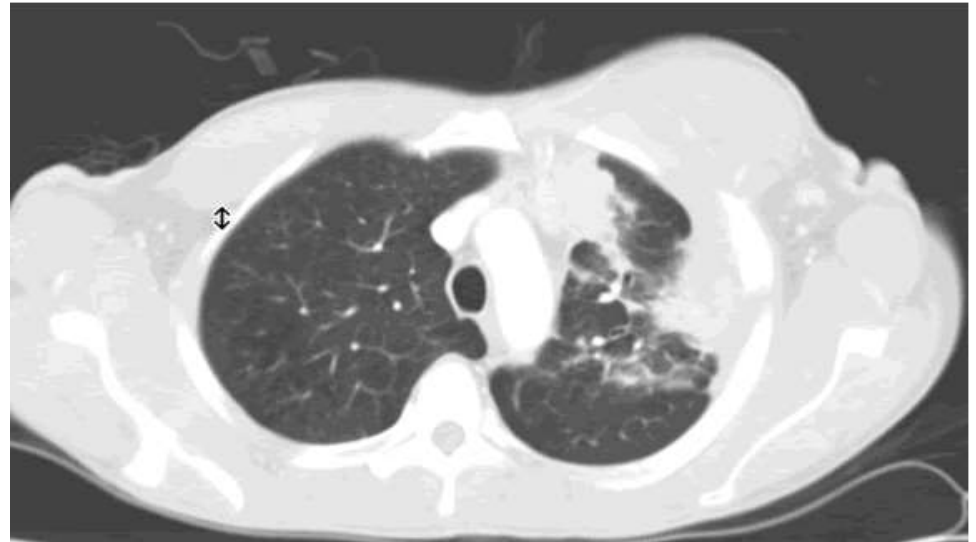
- A lung (pulmonary) consolidation is a region of (normally compressible) organ tissue that has filled with liquid, a condition marked by induration (swelling or hardening of normally soft tissue) of a normally aerated lung
- Consolidation occurs through accumulation of inflammatory cellular exudate in the alveoli and adjoining ducts and is defined as alveolar space that contains liquid instead of gas
- The liquid can be pulmonary edema, inflammatory exudate, pus, inhaled water, or blood (from bronchial tree or hemorrhage from a pulmonary artery)



The photomicrograph shows many alveolar spaces filled with inflammatory infiltrate

Lung consolidation syndrome: diseases

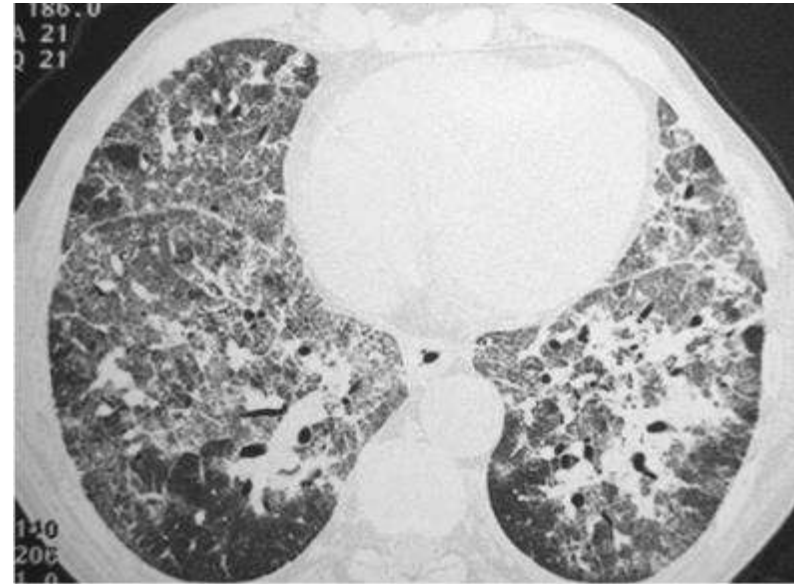
- Pneumonia
- Infections (lung):
actinomycosis, ascariasis,
aspergillosis
(invasive/infection or
allergic), blastomycosis,
cryptococcosis, hydatid
cyst, syphilis
- Atelectasis (collapsed lung)
- Pulmonary edema (fluid in
lungs)
- Tumors of the lung



**The mediastinal lymphadenopathy and lung
consolidation**

Lung consolidation syndrome: symptoms

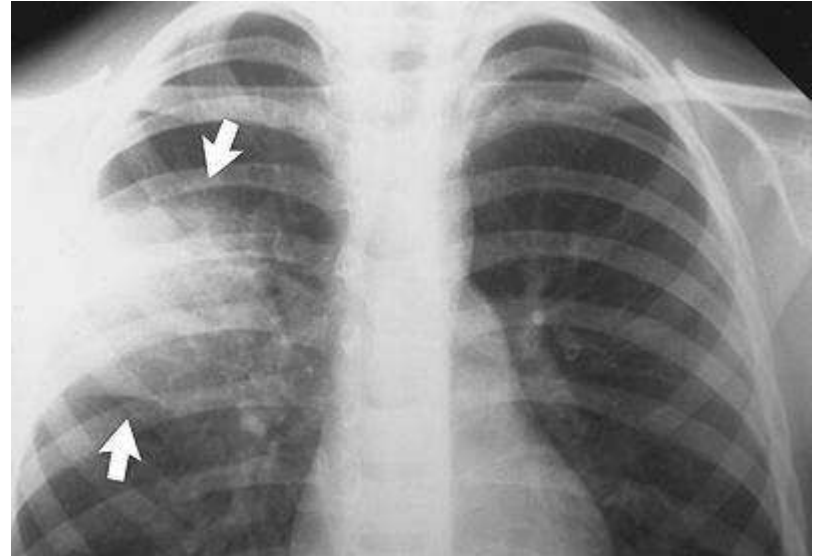
- Dyspnea which is dependent on the extent of consolidation
- Abnormal breathing sounds
- Coughing
- Pallor acrocyanosis
- Percussion : dull note
- Palpation : tactile fremitus
- Vocal resonance
- Bronchial breathing and egophony (it is said to occur when, during auscultation, a patient says the letter “E” and the examiner hears the letter “A”)
- Pleural friction rub
- Unilateral reduction in chest expansion



High-resolution CT scan at level of lower lung zones shows extensive "crazy-paving" pattern involving both lower lobes, lingula and middle lobe, in association with areas of air-space consolidation

Lung consolidation syndrome: X-ray features

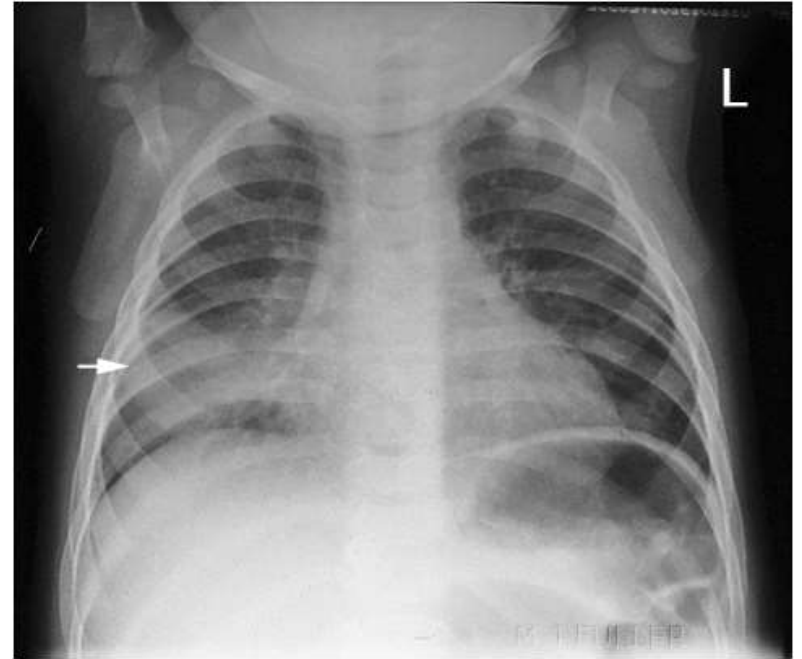
- Opacity of the affected area, lobule or lobe
- Loss of clarity of the heart border, diaphragm and or vertebral bodies (thoracic vertebrae)
- Patchy consolidation may be seen with bronchopneumonia while confluent consolidation seen in lobar pneumonia
- Cavitation, bulging interlobular fissures and pleural effusion may also be evident



The chest X-ray shows an area of lung inflammation indicating the presence of pneumonia

Lung consolidation syndrome: X-ray patterns of consolidation

- Consolidation may be complete or incomplete
- The distribution of the consolidation can vary widely
- A consolidation could be described as “patchy”, “homogenous”, or “generalized”
- A consolidation may be described as focal or by the lobe or segment of lobe affected

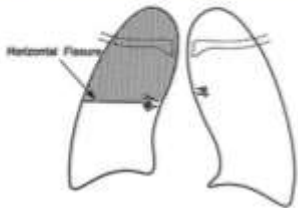


There is abnormal opacity on the right (arrowed). There is also loss of clarity of the right heart border known as silhouette sign

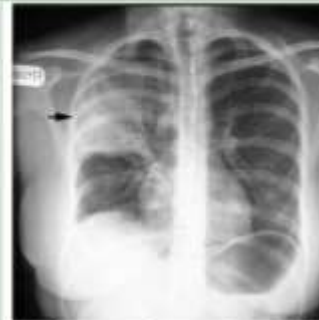
Lung consolidation syndrome:

Right Upper Lobe (RUL) consolidation

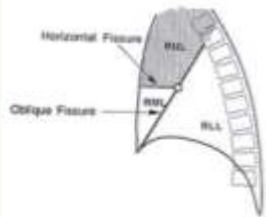
Right Upper Lobe (RUL) Consolidation



RUL consolidation will be seen as an increased opacity within the shaded area. Opacity may be sharply bordered by the horizontal fissure. Some loss of outline of the upper right heart border may be apparent.



- Dense opacity seen above the horizontal fissure.
- Air-bronchogram line



In the lateral view, there will be increased density in the RUL which may be sharply bordered by the horizontal and/or oblique fissure(s).

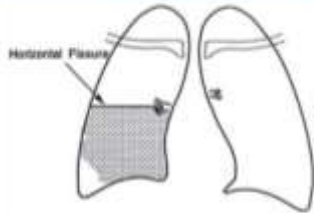


- Dense opacity in the RUL sharply bordered by the horizontal and oblique fissures

Lung consolidation syndrome:

Right Middle Lobe (RML) consolidation

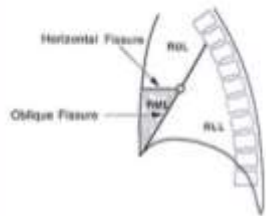
Right Middle Lobe (RML) Consolidation



- Seen as an area of increased opacity in the shaded area
- Loss of the definition of the right heart border is often seen



- RML opacification
- Loss of adjacent right heart border



- RML consolidation is characteristically seen as a wedge opacity in the lateral view
- May be sharply bordered by the horizontal and oblique fissures
- (collapse of the lingula segment of the LUL has a similar appearance)

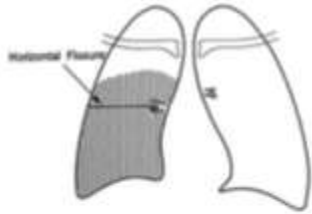


- Wedge shaped opacity characteristic of RML consolidation (black arrow)
- lingula segment consolidation can have a similar appearance on the lateral view
- some RML collapse also present

Lung consolidation syndrome:

Right Lower Lobe (RUL) consolidation

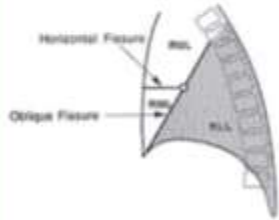
Right Lower Lobe (RLL) Consolidation



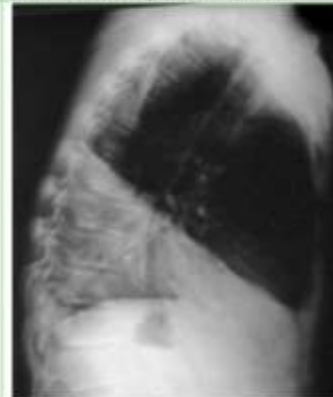
- Appears as an area of increased opacity within the RLL.
- Some loss of the hemi-diaphragm is commonly seen



- Loss of right hemi-diaphragm
- Dense opacity in RLL
- Some loss of right heart border



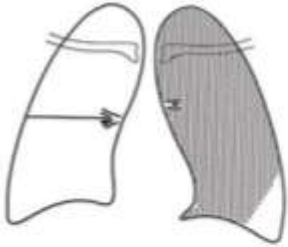
- Increased opacity within the RLL
- Commonly seen with loss of the right hemi-diaphragm



- Triangular opacity
- Loss of right hemi-diaphragm

Lung consolidation syndrome: Left Upper Lobe (RUL) consolidation

Left Upper Lobe (LUL) Consolidation



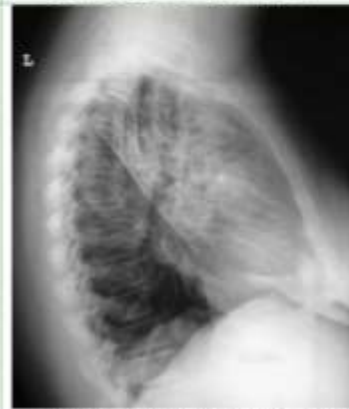
- Appears as an area of increased opacity within the LUL
- Characteristically not a dense opacity on the PA view
- Often loss of the upper mediastinal contour



- Opacity left hemi-thorax
- Air-bronchogram lines
- Some loss of left heart border



- Can be sharply bordered by the oblique fissure
- Does not involve the diaphragm

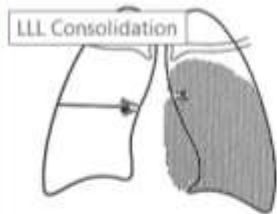


- Opacity seen anterior to the oblique fissure

Lung consolidation syndrome:

Left Lower Lobe (RUL) consolidation

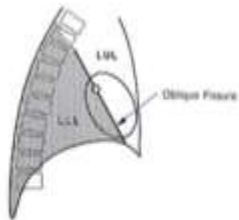
Left Lower Lobe (LLL) Consolidation



- Appears as an area of increased opacity within the LLL
- Some loss of the hemi-diaphragm is commonly seen
- May be increased density behind left heart shadow



- Appears as an area of increased opacity within the LLL
- Some loss of the hemi-diaphragm medially is seen
- increased density behind left heart shadow



- Increased opacity within the LLL
- Commonly seen with loss of the Left hemi-diaphragm
- May be sharply delineated by oblique fissure



- Increased opacity within the LLL
- Loss of the normal darkening of the t spine some loss of the left hemi-diaphragm posteriorly

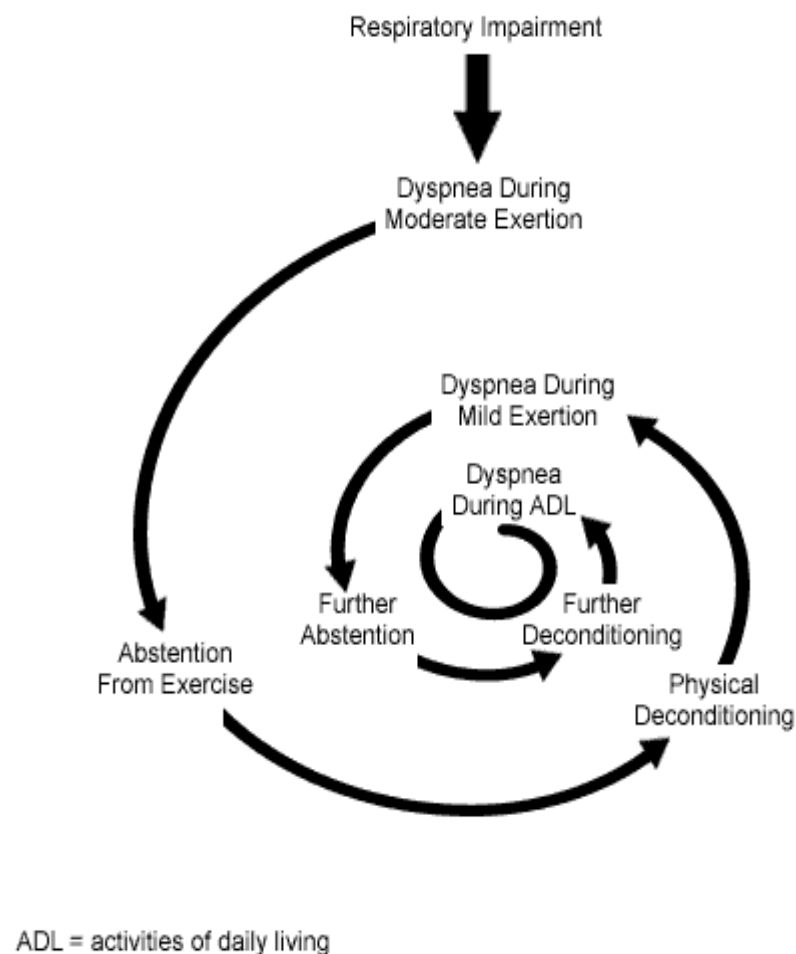
Lung consolidation syndrome: lung ultrasound

- The consolidated lung is 'hepatatised' (looks similar to liver)
- Extensive consolidation (of a whole lobe) allows the opposite plural line to be seen (8-11cm deep) with mediastinum deeper and with the aorta or IVC still visible
- A fully consolidated lobe may be seen floating in a pleural effusion



Respiratory failure: definition and types

- Respiratory failure occurs when the respiratory system fails in oxygenation and/or carbon dioxide (CO₂) elimination.
- It may be acute (develops over minutes to hours) or chronic (develops over several weeks-months (clinical markers include polycythemia and cor pulmonale))
- Types:
 - I - Hypoxemic (PaO₂ is less than 60 mm Hg (8 kPa) with a normal or low PaCO₂) caused by ventilation-perfusion mismatch
 - II - Hypercapnic (PaCO₂ is more than 50 mm Hg (6.5 kPa) and indicates inadequate alveolar ventilation)



Respiratory failure: causes

Type I

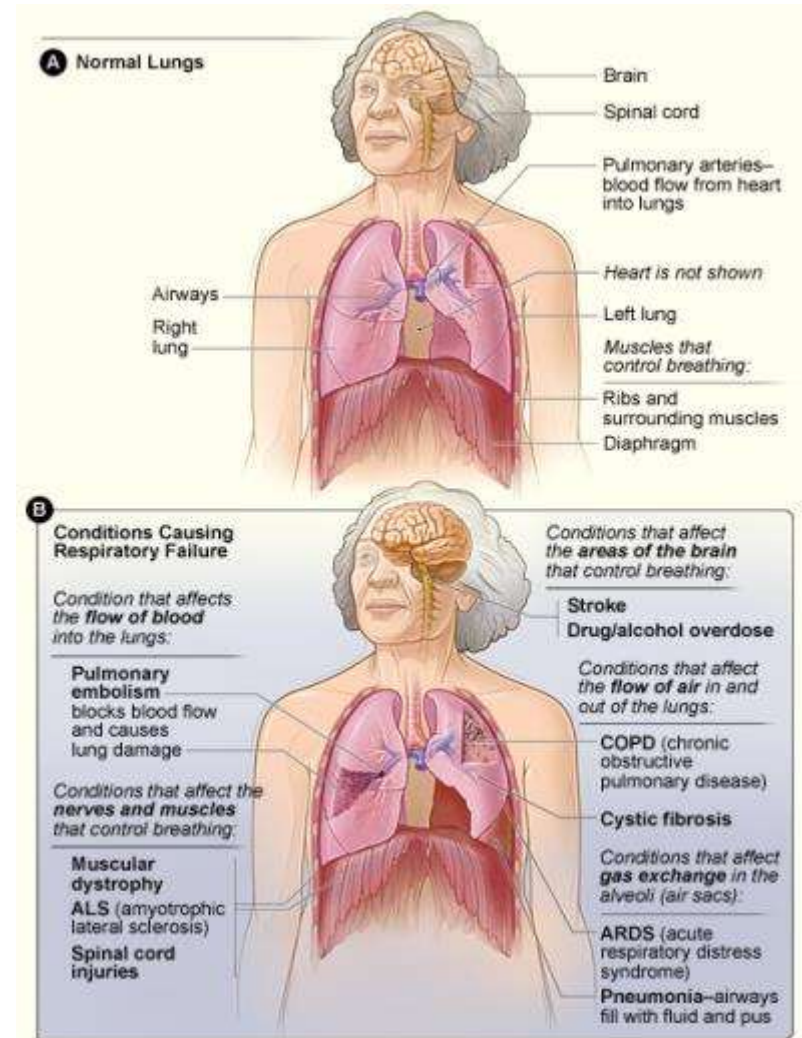
- Chronic obstructive pulmonary disease (COPD)
- Pneumonia
- Pulmonary oedema
- Pulmonary fibrosis
- Asthma
- Pneumothorax
- Pulmonary embolism
- Pulmonary hypertension
- Cyanotic congenital heart disease
- Bronchiectasis
- Acute respiratory distress syndrome
- Kyphoscoliosis
- Obesity

Type II

- COPD
- Severe asthma
- Drug overdose, poisoning
- Myasthenia gravis
- Polyneuropathy
- Poliomyelitis
- Muscle disorders
- Head injuries
- Neck injuries
- Obesity
- Pulmonary oedema
- Adult respiratory distress syndrome
- Hypothyroidism

Respiratory failure: causes

- Conditions that affect the nerves and muscles that control breathing (examples include muscular dystrophy, amyotrophic lateral sclerosis (ALS), spinal cord injuries, and stroke)
- Damage to the tissues and ribs around the lungs
- Problems with the spine, such as scoliosis (a curve in the spine)
- Drug or alcohol overdose (an overdose affects the area of the brain that controls breathing)
- Lung diseases and conditions, such as chronic obstructive pulmonary disease, pneumonia, acute respiratory distress syndrome (ARDS), pulmonary embolism, and cystic_fibrosis
- Acute lung injuries (e.g., inhaling harmful fumes or smoke)



Respiratory failure: signs and symptoms

- Paroxysmal nocturnal dyspnoea
- Orthopnoea
- Pulmonary oedema
- Cyanosis
- Confusion and reduced consciousness
- Localised pulmonary findings
- Tachycardia and cardiac arrhythmias
- Hypoxemia
- Acidosis
- Cor pulmonale (pulmonary hypertension, right ventricular failure, hepatomegaly and peripheral oedema)

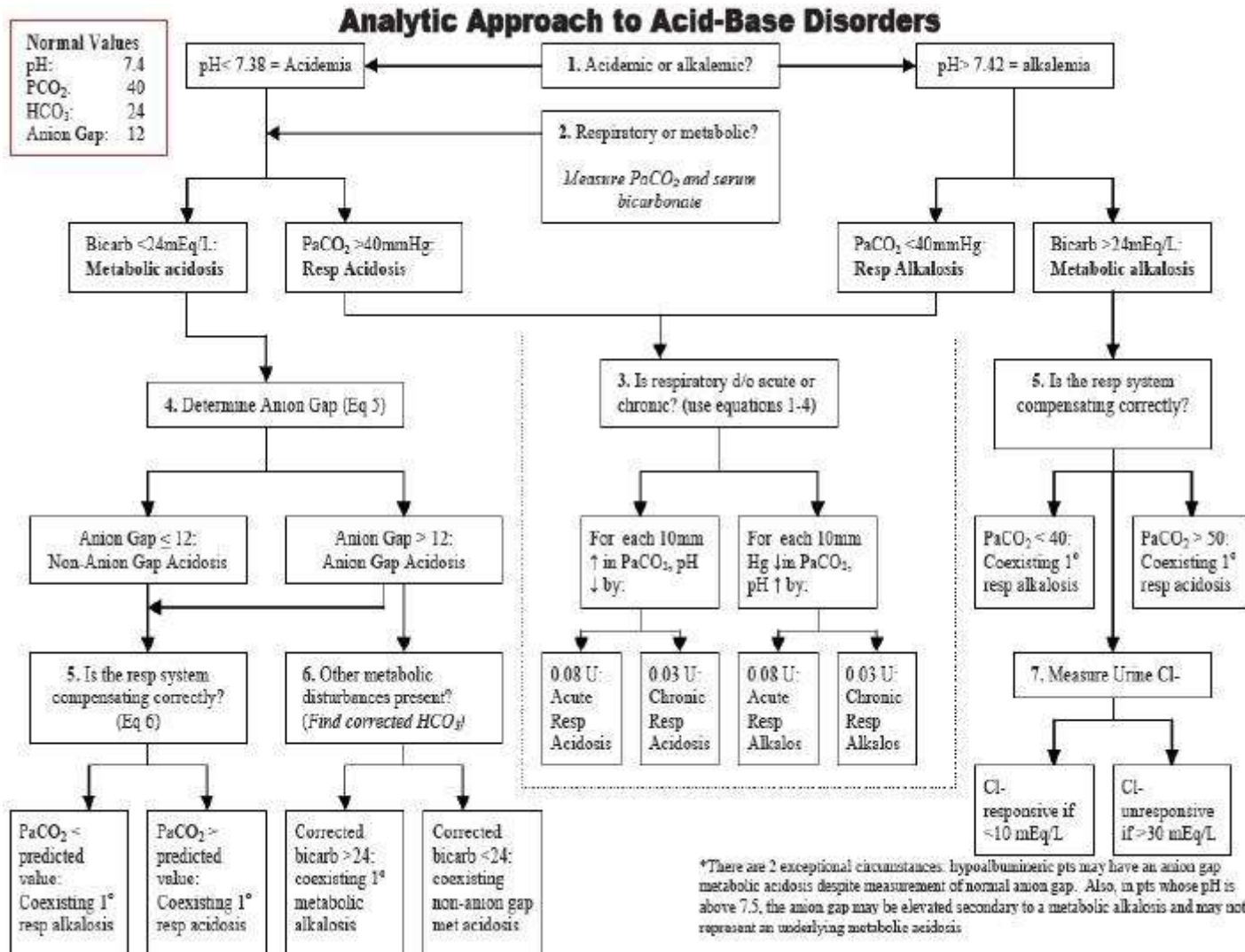


A transverse section of the heart from a patient with primary (idiopathic) pulmonary hypertension

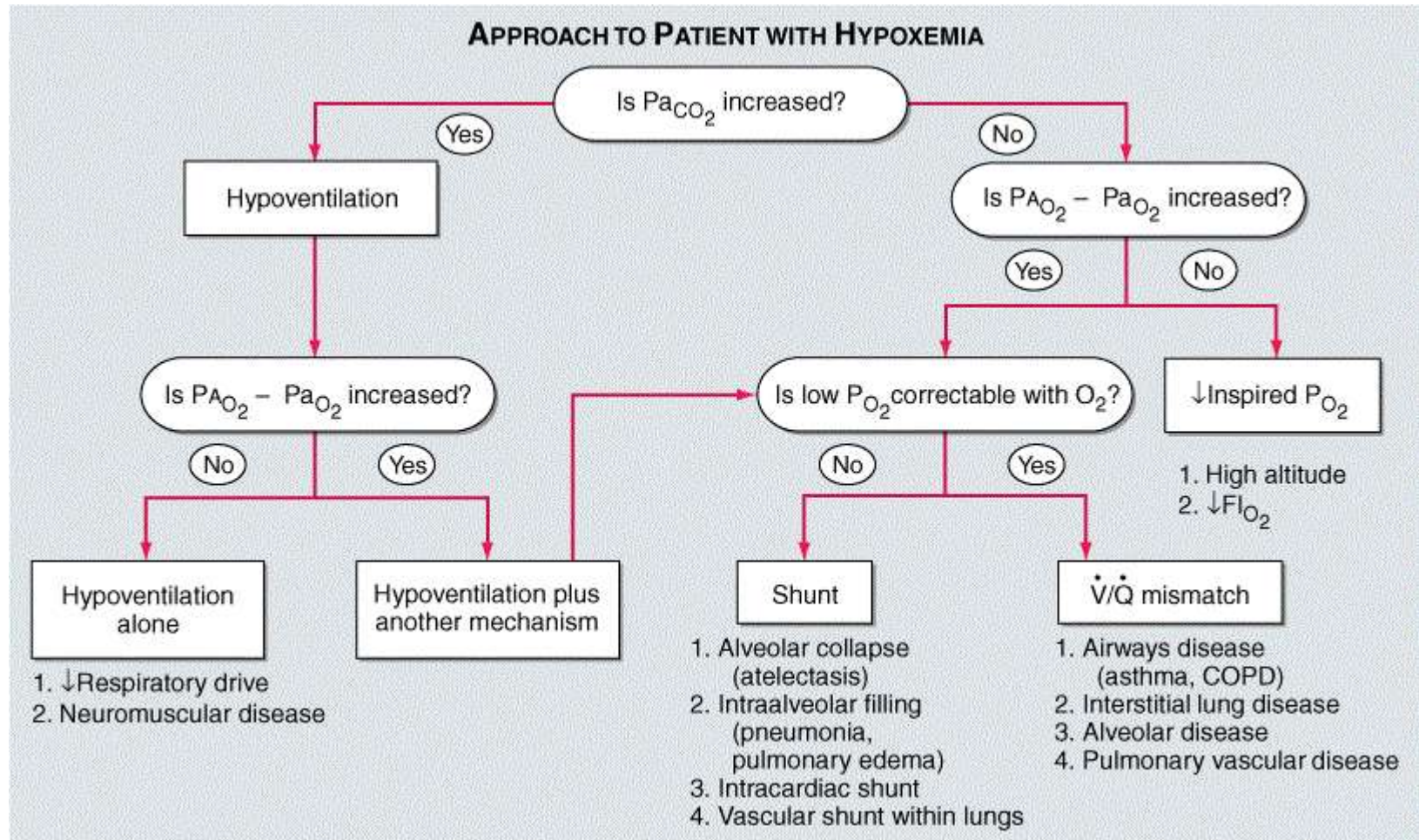
Respiratory failure: diagnostic tests

- Pulmonary function tests (spirometry, arterial blood gas test, etc.)
- Chest X-ray
- Full Blood Count (anemia contributes to hypoxia, polycythemia contributes to chronic hypoxemic respiratory failure)
- Renal and liver function tests (may provide clues to the etiology or identify complications associated with respiratory failure)
- Serum creatine kinase and troponin I (to help exclude recent myocardial infarction)
- Thyroid Function Test (hypothyroid chronic hypercapnic respiratory failure)
- Echocardiography (cardiac cause of acute respiratory failure)
- ECG (cardiovascular cause, dysrhythmias resulting from severe hypoxaemia or acidosis)
- Right heart catheterisation (if there is uncertainty about cardiac function)
- Pulmonary capillary wedge pressure (distinguishing cardiogenic from noncardiogenic edema)

Respiratory failure: arterial blood gas test



Respiratory failure: arterial blood gas test



The lung compression syndrome: atelectasis (definition and types)

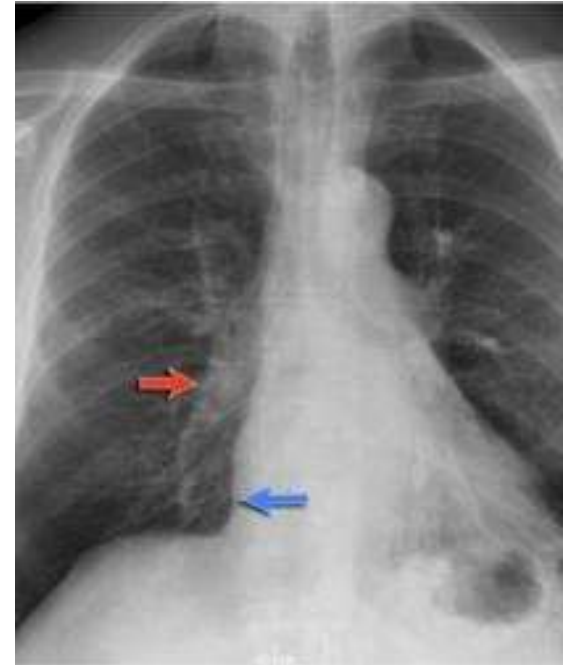
- Atelectasis is defined as the collapse of part or all of the lungs; when this occurs, for whatever reason, fresh air does not reach the tiniest of airways, and oxygen and carbon dioxide can't be exchanged; this, in turn, can lead to decreased levels of oxygen being delivered to the organs and tissues of the body (hypoxia)
- Atelectasis may be acute, occurring suddenly over a matter of minutes, or chronic, developing over a period of days to weeks
- Atelectasis may be the result of a blocked airway (obstructive) or of pressure from outside the lung (nonobstructive)
- Almost everyone who has surgery has some atelectasis from anesthesia
- Atelectasis is particularly prominent after heart bypass surgery

The lung compression syndrome: atelectasis (mechanisms)

1. Obstruction: blockage of an airway, either from inside (by a foreign body that is aspirated, or a mucous plug), or the outside (e.g., by a lung cancer pressing on the airway),
2. Compression: compression of the airways in the lungs can be caused by fluid or air surrounding the lungs (as in a pleural_effusion or a pneumothorax); by enlargement or an aneurysm of the heart; by tumors such as cancers metastatic to the lungs, lymphomas, or enlarged lymph nodes; or by abdominal distention which causes pressure on the lungs
3. Adhesion: when the surfactant is lacking, the lungs lose surface tension and can collapse; this is the cause of respiratory distress in newborns and can also occur in adults with adult respiratory distress syndrome (ARDS), smoke inhalation, and kidney failure
4. Hypoventilation: failure to take deep breaths can result in collapse of part of the lungs during surgery, especially with general anesthesia, and when breathing is shallow due to pain (such as with rib fractures)

The lung compression syndrome: atelectasis (obstructive atelectasis causes)

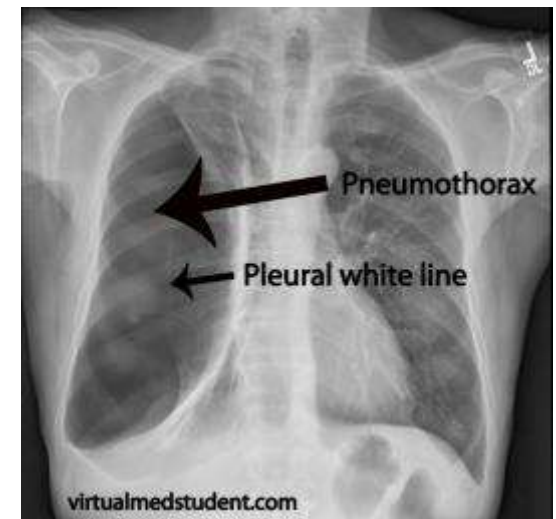
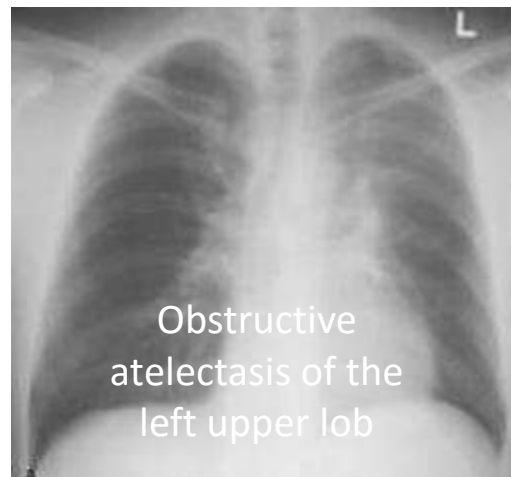
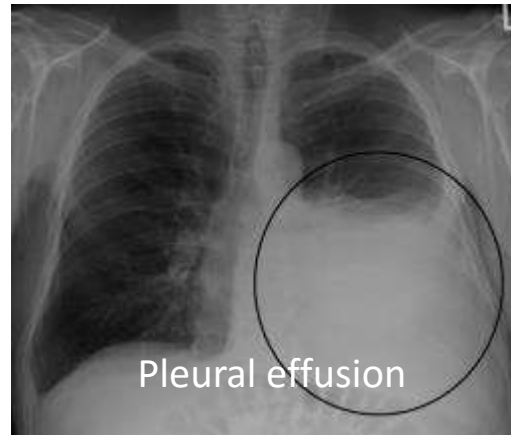
- Mucus plug after accumulation of mucus in airways, often occurring during and after surgery, in children, people with cystic fibrosis and during severe asthma attacks
- Foreign body is common in children who have inhaled an object, such as a peanut or small toy part, into their lungs
- Narrowing of major airways from disease (chronic infections, including fungal infections, tuberculosis and other diseases)
- Tumor in a major airway
- Blood clot after significant bleeding into the lungs that can't be coughed out



Lower lobe atelectasis

The lung compression syndrome: atelectasis (nonobstructive atelectasis causes)

- Injury (chest trauma)
- Pleural effusion
- Pneumonia
- Pneumothorax
- Scarring of lung tissue
- Tumor



The lung compression syndrome: atelectasis (symptoms)

- Atelectasis may have few or no symptoms if it develops slowly or involves only a small portion of the lungs
- Conversely, if the condition affects a large portion of the lungs, or develops rapidly, symptoms may be dramatic and may even progress to shock
- Common symptoms include:
 - Shortness of breath – a sensation of breathlessness is the most common symptom
 - Coughing – this cough is often described as “hacking” and is most often non-productive, meaning that no mucous is coughed up
 - Pleurisy – chest pain that is sharp and worsens with a deep breath or coughing (pleuritic chest pain) may occur
 - Fever – at one time, it was thought that fever was a sign

The lung compression syndrome: atelectasis (diagnosis)

- Physical exam: findings may include quiet or absent breath sounds
- Chest x-ray: the trachea and heart may be deviated towards the side of the chest where a lung is partially collapsed; the diaphragm may also be elevated on the side of the collapse
- Chest CT scan: may further define an area of possible atelectasis and to look for other causes of obstruction, such as tumors or enlarged lymph nodes
- Bronchoscopy: may be used to determine the cause of a bronchial obstruction
- Blood gases or oximetry: may be done to determine how much atelectasis is interfering with the ability to get oxygen to your tissues
- Other tests may be ordered depending upon the condition; for example, a bloodwork to evaluate kidney function

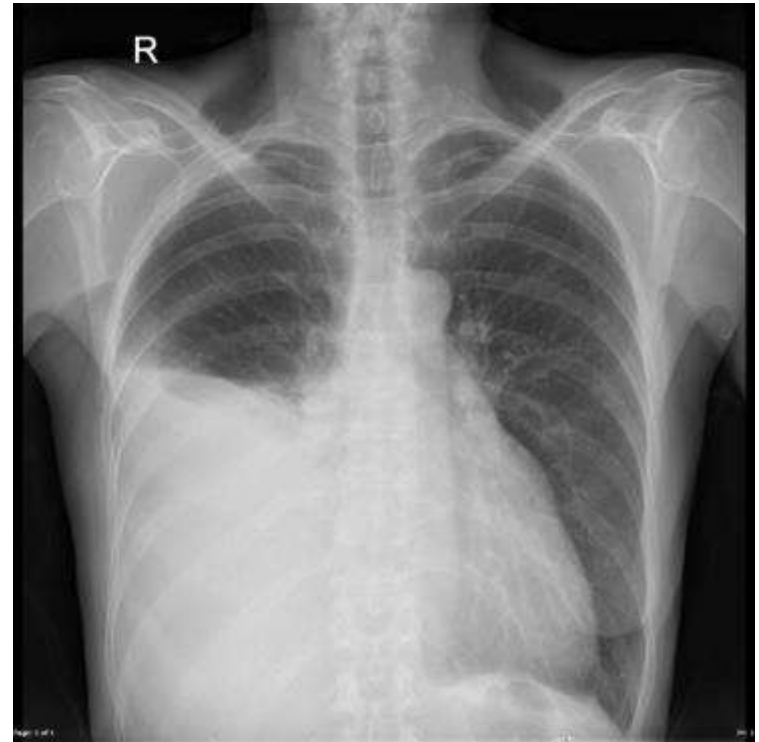
The lung compression syndrome: atelectasis (bronchoscopy)



A peanut in the left main bronchus

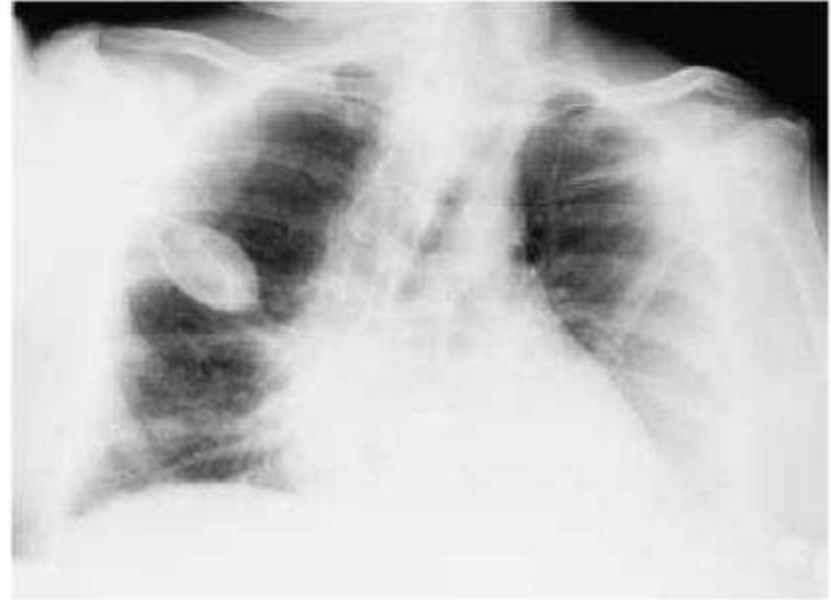
The lung compression syndrome: pleural effusion (definition and types)

- Pleural effusion is excess fluid that accumulates in the pleural cavity, the fluid-filled space that surrounds the lungs
- The fluid excess can impair breathing by limiting the expansion of the lungs (>500 ml)
- Various kinds of pleural effusion, depending on the nature of the fluid and what caused its entry into the pleural space, are hydrothorax (serous fluid), hemothorax (blood), urinothorax (urine), chylothorax (chyle), or pyothorax (pus)



The lung compression syndrome: transudative causes of pleural effusion

- Congestive Heart Failure (CHF)
- Liver cirrhosis
- Hypoproteinemia
- Nephrotic syndrome
- Acute atelectasis
- Myxedema
- Peritoneal dialysis
- Obstructive uropathy
- End-stage kidney disease



The ovoid or lenticular opacity in the right upper lung zone is an interlobar effusion collected in the minor fissure; such effusions are sometimes mistaken for tumors of the lung parenchyma. Interlobar effusions resolve with treatment of the heart failure; hence, they are sometimes called vanishing tumors, or pseudotumors.

The lung compression syndrome: exudative causes of pleural effusion

- Pneumonia
- Cancer
- Pulmonary embolism
- Kidney disease
- Inflammatory disease



A left lower lobe consolidation, representing pneumonia. The meniscus in the left costophrenic angle indicating a parapneumonic left pleural effusion.

The lung compression syndrome: other less common causes of pleural effusion

- Tuberculosis
- Autoimmune disease
- Bleeding (due to chest trauma)
- Chylothorax (due to trauma)
- Rare chest and abdominal infections
- Asbestos pleural effusion (due to exposure to asbestos)
- Meig's syndrome (due to a benign ovarian tumor)
- Ovarian hyperstimulation syndrome



The pleural effusions syndrome: symptoms

- Pleural effusions often cause no symptoms
- Symptoms are more likely when a pleural effusion is moderate or large-sized, or if inflammation is present
- Symptoms of pleural effusions may include:
 - Shortness of breath
 - Chest pain, especially on breathing in deeply (pleurisy, or pleuritic pain)
 - Fever
 - Cough

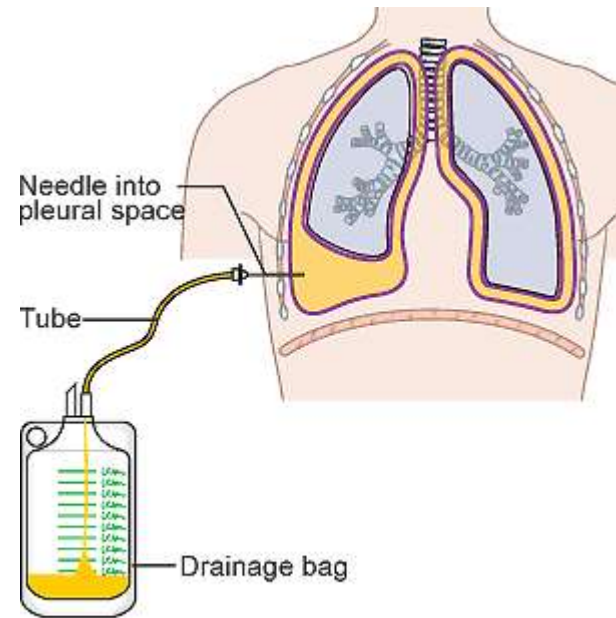


Diagram showing how a pleural effusion is drained
© CancerHelp UK

**Drain of fluid in lungs after
heart surgery**

The pleural effusions syndrome: diagnosis

- Pleural effusion is usually diagnosed on the basis of medical history and physical exam, and confirmed by chest x-ray
- Once accumulated fluid is more than 300 ml, there are usually detectable clinical signs in the patient, such as decreased movement of the chest on the affected side, stony dullness to percussion over the fluid, diminished breath sounds on the affected side, decreased vocal resonance and fremitus (though this is an inconsistent and unreliable sign), and pleural friction rub
- Above the effusion, where the lung is compressed, there may be bronchial breathing and egophony
- A large effusion there may cause tracheal deviation away from the effusion

The pleural effusions syndrome: the commonly used tests

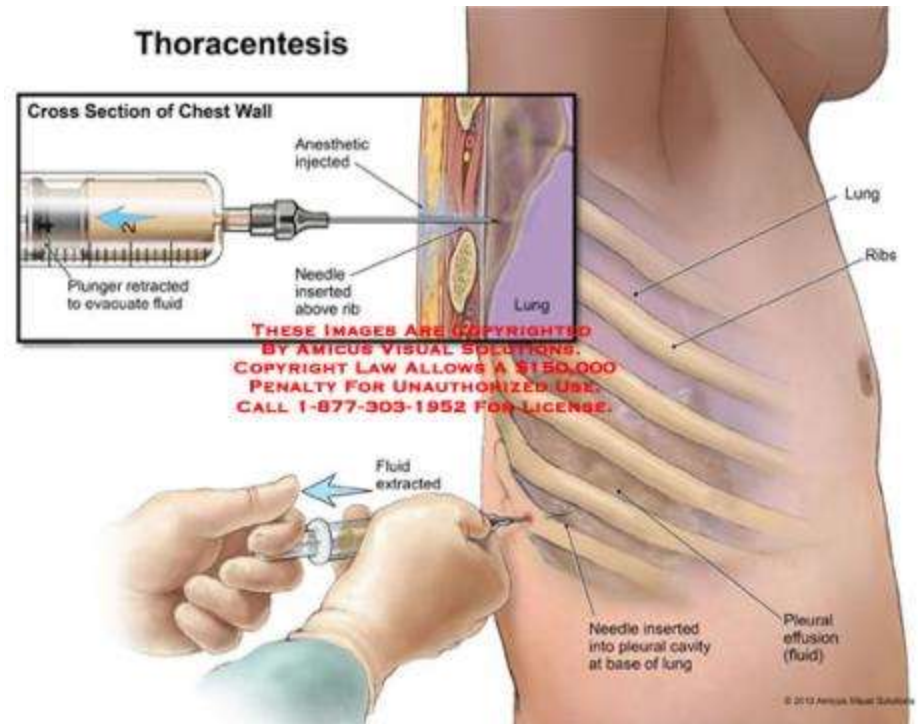
- Chest x-ray
- Computed tomography (CT) scan of the chest
- Ultrasound of the chest
- Thoracentesis
- Pleural fluid analysis (an examination of the fluid removed from the pleura space)



CT chest scan showing massive left pleural effusion

The pleural effusions syndrome: thoracentesis

- Pleural fluid is drawn out of the pleural space in a process called thoracentesis, and it should be done in almost all patients who have pleural fluid that is ≥ 10 mm in thickness
- In thoracentesis, a needle is inserted through the back of the chest wall in the sixth, seventh, or eighth intercostal space on the mid axillary line, into the pleural space



The pleural effusions syndrome: pleural fluid investigation

- Pleural fluid red cell counts are elevated in cases of bloody effusions (e.g., after heart surgery or hemothorax)
- Pleural fluid amylase is elevated in cases of esophageal rupture, pancreatic pleural effusion, or cancer
- Glucose is decreased with cancer, bacterial infections, or rheumatoid pleuritis
- Pleural fluid pH is low in empyema (<7.2) and may be low in cancer
- If cancer is suspected, the pleural fluid is sent for cytology; if cytology is negative, either a thoracoscopy, or needle biopsy of the pleura may be performed
- The fluid is also sent for Gram staining and culture, and, if suspicious for tuberculosis, examination for TB markers (adenosine deaminase > 45 IU/L, interferon gamma > 140 pg/mL, or positive polymerase chain reaction (PCR) for tuberculous DNA)
- Once pleural effusion identified as exudative, additional evaluation is needed to determine the cause of the excess fluid, and pleural fluid is sampled for amylase, glucose, pH and cell counts

The pleural effusions syndrome: light's criteria transudate vs. exudate

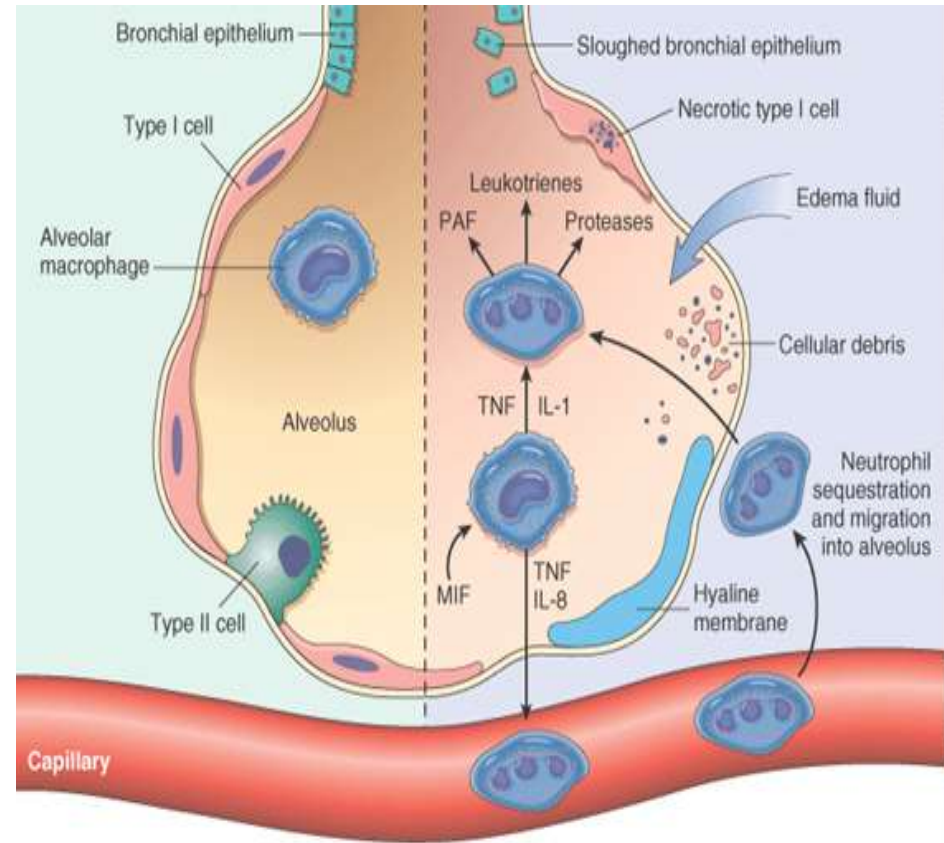
Parameters	Transudate	Exudate
Main causes	↑ hydrostatic pressure, ↓ colloid osmotic pressure	Inflammation-increased vascular permeability
Appearance	Clear	Cloudy
Specific gravity	< 1.012	> 1.020
Protein content	< 2.5 g/dL	> 2.9 g/dL
fluid protein/serum protein	< 0.5	> 0.5
Difference of albumin content with blood albumin	> 1.2 g/dL	< 1.2 g/dL
fluid LDH upper limit for serum	< 0.6 or < $\frac{2}{3}$	> 0.6 or > $\frac{2}{3}$
Cholesterol content	< 45 mg/dL	> 45 mg/dL

Acute respiratory distress syndrome (ARDS): definition and causes

- Acute respiratory distress syndrome (respiratory distress syndrome (RDS), acute lung injury, adult respiratory distress syndrome, shock lung) is a severe, life-threatening medical condition characterized by widespread inflammation in the lungs
- Common causes of ARDS include sepsis, pneumonia, trauma, multiple blood transfusions, babesiosis, lung contusion, aspiration of stomach contents, and drug abuse or overdose
- Other causes of ARDS include burns, pancreatitis, near drowning, or the inhalation of chemical irritants such as smoke, phosgene, or chlorine gas
- Some cases of ARDS are linked to large volumes of fluid used during post-trauma resuscitation
- The syndrome has a high mortality between 20 and 50%

Acute respiratory distress syndrome (ARDS): mechanisms

- ARDS is a pathology of the microscopic air sacs of the lungs (alveoli) that leads to decreased exchange of oxygen and carbon dioxide (gas exchange)
- ARDS is associated with several pathologic changes: the release of inflammatory chemicals, breakdown of the cells lining the lung's blood vessels, surfactant loss leading to increased surface tension in the lung, fluid accumulation in the lung, and excessive fibrous connective tissue formation



Acute respiratory distress syndrome (ARDS): signs and symptoms

- The signs and symptoms usually begin within 72 hours of the initial insult or injury to the lung and may include severe shortness of breath, fast breathing, cough, and a low oxygen level in the blood
- A chest x-ray frequently demonstrates generalized infiltrates or opacities in both lungs, which represent fluid accumulation in the lungs
- Other signs and symptoms may be associated with the underlying disease process (e.g., low blood pressure and fever)



Acute respiratory distress syndrome (ARDS): diagnosis

The "Berlin criteria" of 2012 proposed by the European Society of Intensive Care Medicine, endorsed by the American Thoracic Society and the Society of Critical Care Medicine:

- Acute onset
- Bilateral infiltrates on chest radiograph sparing costophrenic angles
- Pulmonary artery wedge pressure < 18 mmHg (obtained by pulmonary artery catheterization), if this information is available; if unavailable, then lack of clinical evidence of left atrial hypertension
- if $\text{PaO}_2:\text{FiO}_2 < 300$ mmHg (40 kPa) acute lung injury (ALI) is considered to be present
- if $\text{PaO}_2:\text{FiO}_2 < 200$ mmHg (26.7 kPa) acute respiratory distress syndrome (ARDS) is considered to be present



Lecture 12

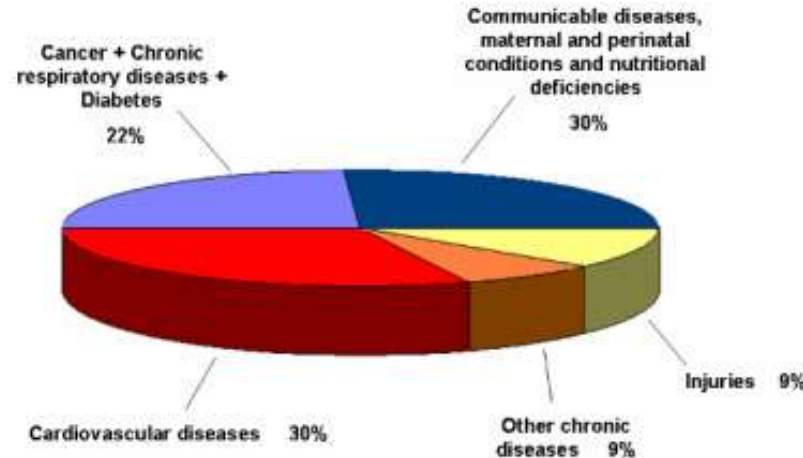
Syndromes of cardiovascular system diseases

Plan of the lecture

- The importance of the cardiovascular system
- Reminder
 - The primary function
 - How does cardiovascular system work
 - Purpose
 - History-taking
 - Patient examination
 - Clinical
 - Laboratory
 - Instrumental
 - Imaging
 - Other tests
- Spectrum of cardiovascular system diseases
- Syndromes of cardiovascular system diseases
- Acquired valvular heart defects
 - (Arterial) hypertension
 - Coronary insufficiency
 - Heart failure
- Glossary of cardiovascular system pathology' terms

The importance of the cardiovascular system

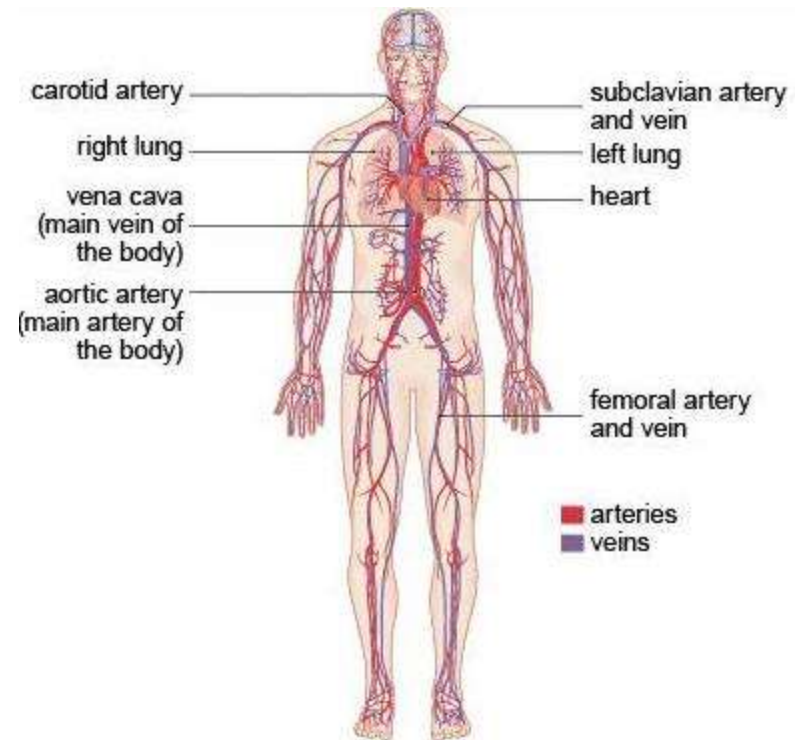
- Cardiovascular diseases (CVDs) are the number 1 cause of death globally: more people die annually from CVDs than from any other cause
- An estimated 17.5 million people died from CVDs in 2012, representing 31% of all global deaths
- Over three quarters of CVD deaths take place in low- and middle-income countries
- Out of the 16 million deaths under the age of 70 due to noncommunicable diseases, 82% are in low and middle income countries and 37% are caused by CVDs



Reminder: : the cardiovascular system functions

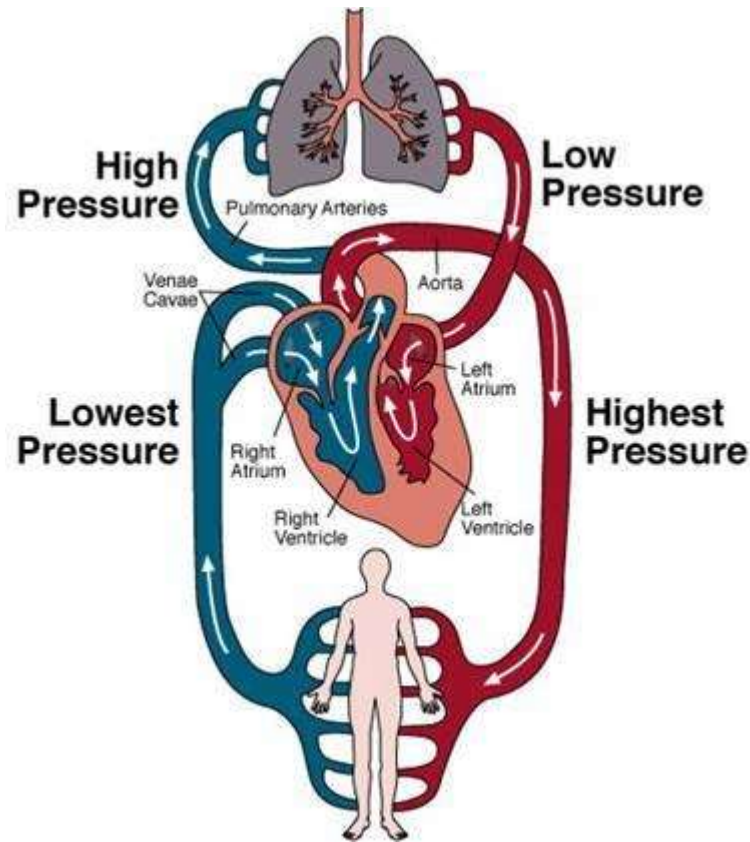
The four major functions of the cardiovascular system are:

1. To transport nutrients, gases and waste products around the body
2. To protect the body from infection and blood loss
3. To help the body maintain a constant body temperature ('thermoregulation')
4. To help maintain fluid balance within the body



The main organs, arteries and veins in the cardiovascular system

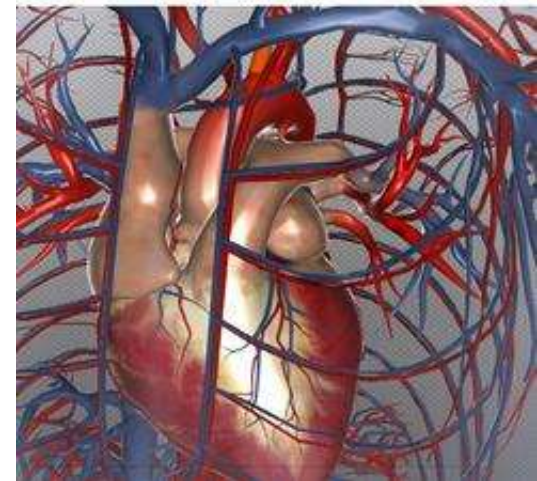
Reminder: how does the cardiovascular system work



<http://www.mayoclinic.org/diseases-conditions/heart-disease/multimedia/circulatory-system/vid-20084745>

Reminder: purpose

- General evaluation of health
- Diagnosis of disease or disorders of the cardiovascular system
- Diagnosis of other systemic diseases that affect cardiovascular system functions
- Monitoring of patients with cardiovascular system diseases



History-taking (patient interviewing)

- Gathering of information
- patient's narrative
- Biomedical perspective
- Psychosocial perspective
- Context



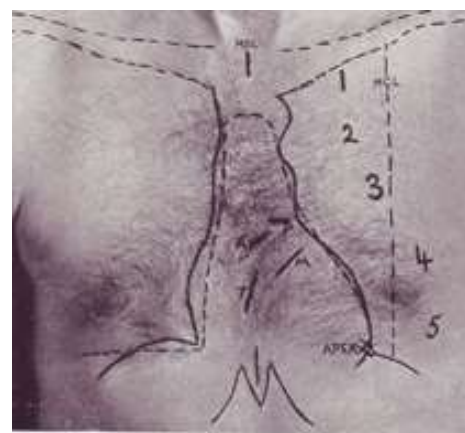
Patient clinical examination



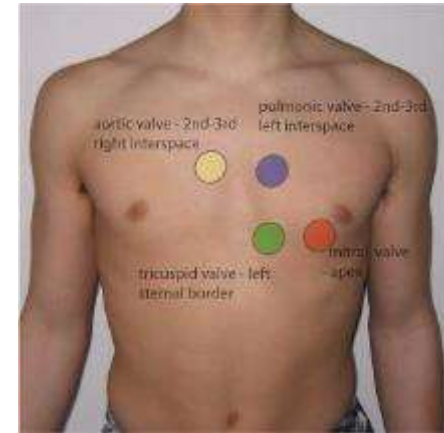
Inspection



Palpation



Percussion



Auscultation

Laboratory tests ordinarily used for examination of patients with cardiovascular diseases

Test Name	Lower/normal risk	High risk
Total Cholesterol	<200 mg/dL	>240 mg/dL
LDL-C	<100 mg/dL	>160 mg/dL
HDL-C	>60 mg/dL	<40 mg/dL
Triglyceride	<150 mg/dL	>200 mg/dL
Blood Pressure	<120/80 mmHg	>140/90 mmHg
C-reactive protein	<1 mg/L	>3 mg/L
Fibrinogen	<300 mg/dL	>460 mg/dL
Homocysteine	<10 μ mol/L	>14 μ mol/L
Fasting Insulin	<15 μ IU/mL	>25 μ IU/mL
Ferritin	male 12–300 ng/mL female 12–150 ng/mL	
Lipoprotein (a) - Lp(a)	<14 mg/dL	>19 mg/dL
Calcium Heart Scan	<100	>300

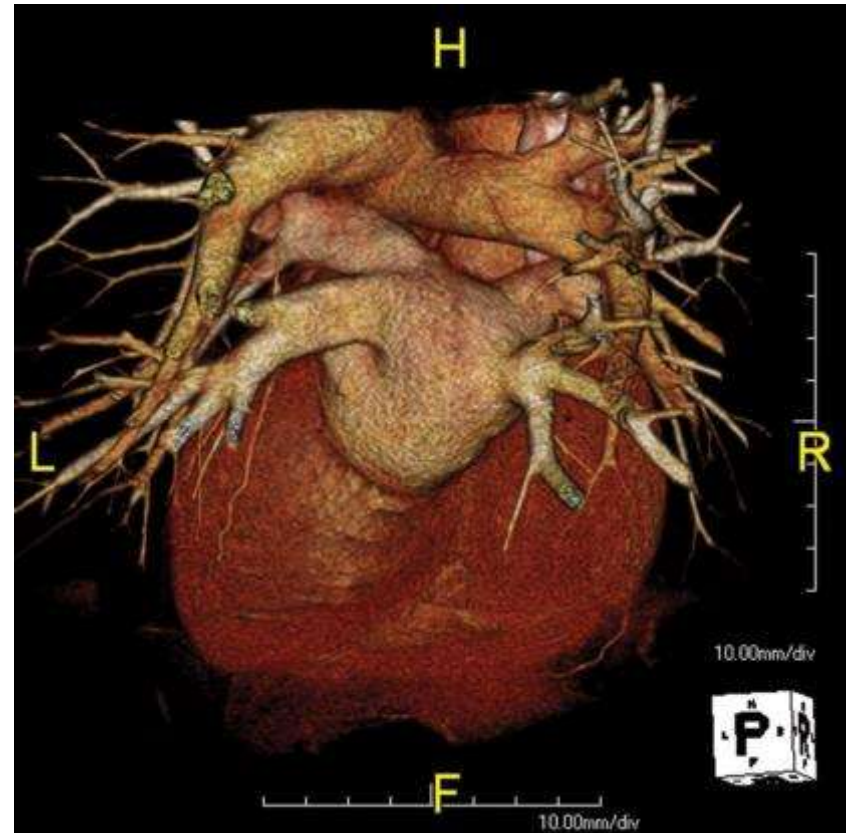
Patient laboratory examination: additional tests

- Homocysteine
- Blood sugar control (fasting, after eating or averages using glycosylated albumen or hemoglobin)
- Myoglobin
- Creatine kinase
- Troponin
- Brain-type natriuretic peptide
- etc.



Patient instrumental examination

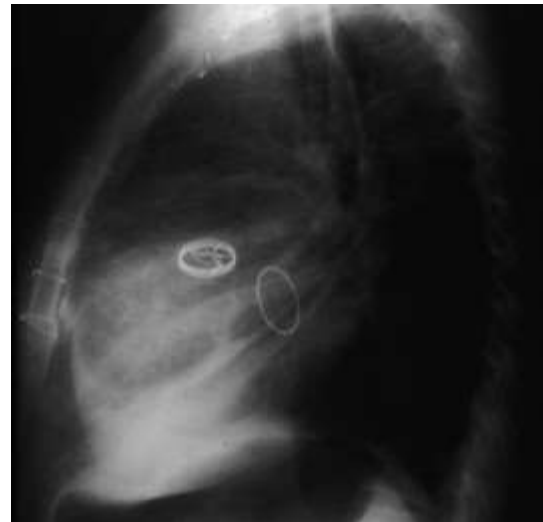
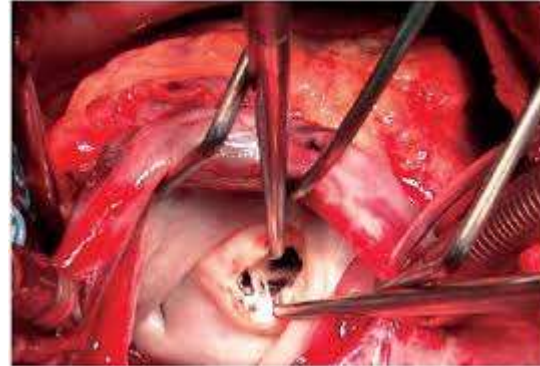
- Electrocardiogram
- Holter Monitoring
- Event monitoring
- Blood Pressure Monitoring
- Stress Testing (Exercise Treadmill Test)
- Echocardiograms
- Venous Duplex or Venous Doppler Studies
- Arterial Segmental Pressure Studies
- Carotid Doppler Studies
- Electrophysiology study
- Cardiac imaging techniques include coronary catheterization, computer tomography (CT), etc.



Pulmonary venous anatomy by cardiac CT

Types of cardiovascular system diseases and syndromes

- Ischemic heart disease
- Arterial hypertension
- Cardiomyopathies
- Rheumatic heart disease
- Congenital heart diseases/abnormalities (conductive system, valves, vessels, heart defects)
- Inflammatory diseases (endocarditis, myocarditis, pericarditis)
- Peripheral vascular disease
- Heart failure
- Cerebrovascular disease (Stroke)

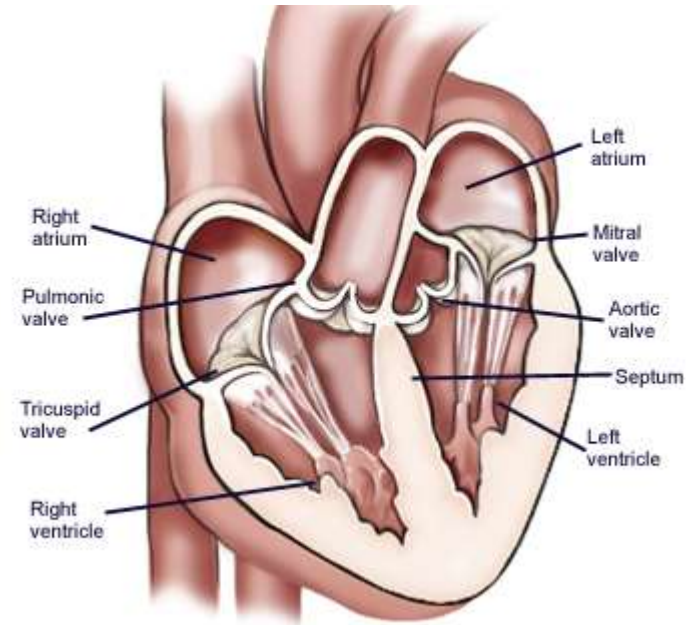
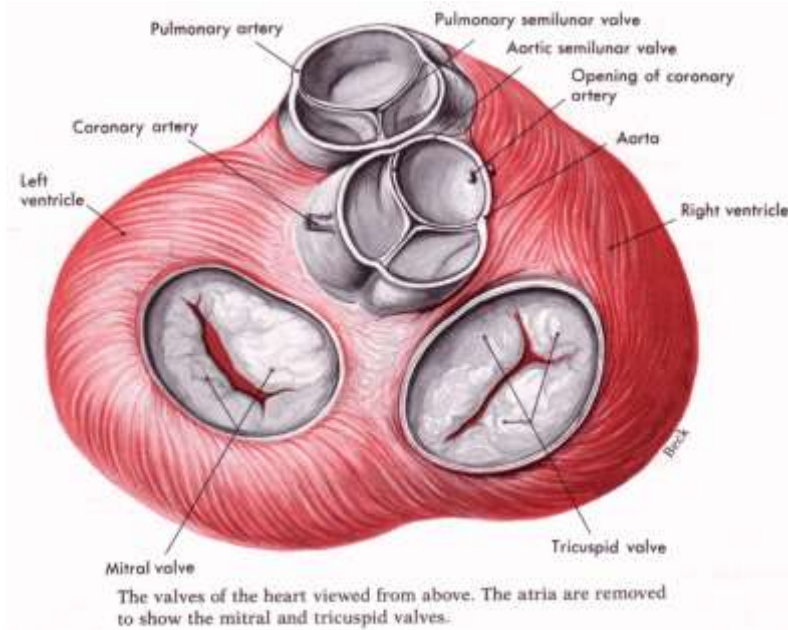


Acquired valvular heart defects

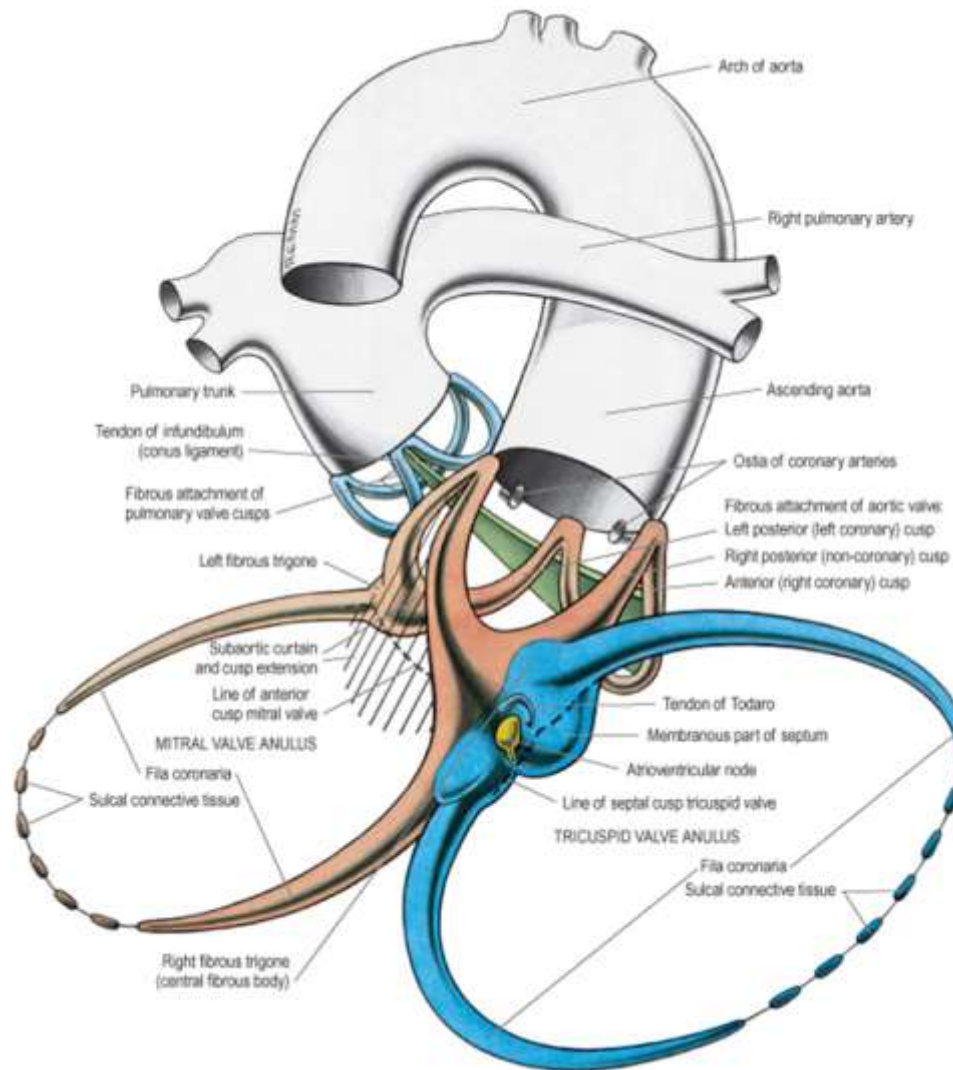
Acquired valvular heart defects: definition, classification

- The heart valves are part of the dense connective tissue makeup of the heart known as the heart skeleton
- Valves that are formed properly at birth can still develop problems (acquired valvular heart defects) related to aging, infection, heart attack, damage and other events that cause wear and tear to the valves, e.g. by a build-up of calcium deposits on the valve leaflets, making them stiff and inflexible
- Acquired valvular heart defects develop after birth and may involve one or more of the four valves of the heart (the aortic and mitral valves on the left and the pulmonary and tricuspid valves on the right)
- The two major types defects of everyone heart valve are:
 - Insufficiency/regurgitation (the valve's tissue flaps (leaflets), which control the flow and direction of the blood, do not fully close or the edges do not fully meet, which causes blood to leak back into the heart)
 - Stenosis (the leaflets cannot open fully to allow enough blood to flow through)
- The aortic and mitral valves are the ones that most commonly become affected by acquired heart valve pathological processes

Heart valves

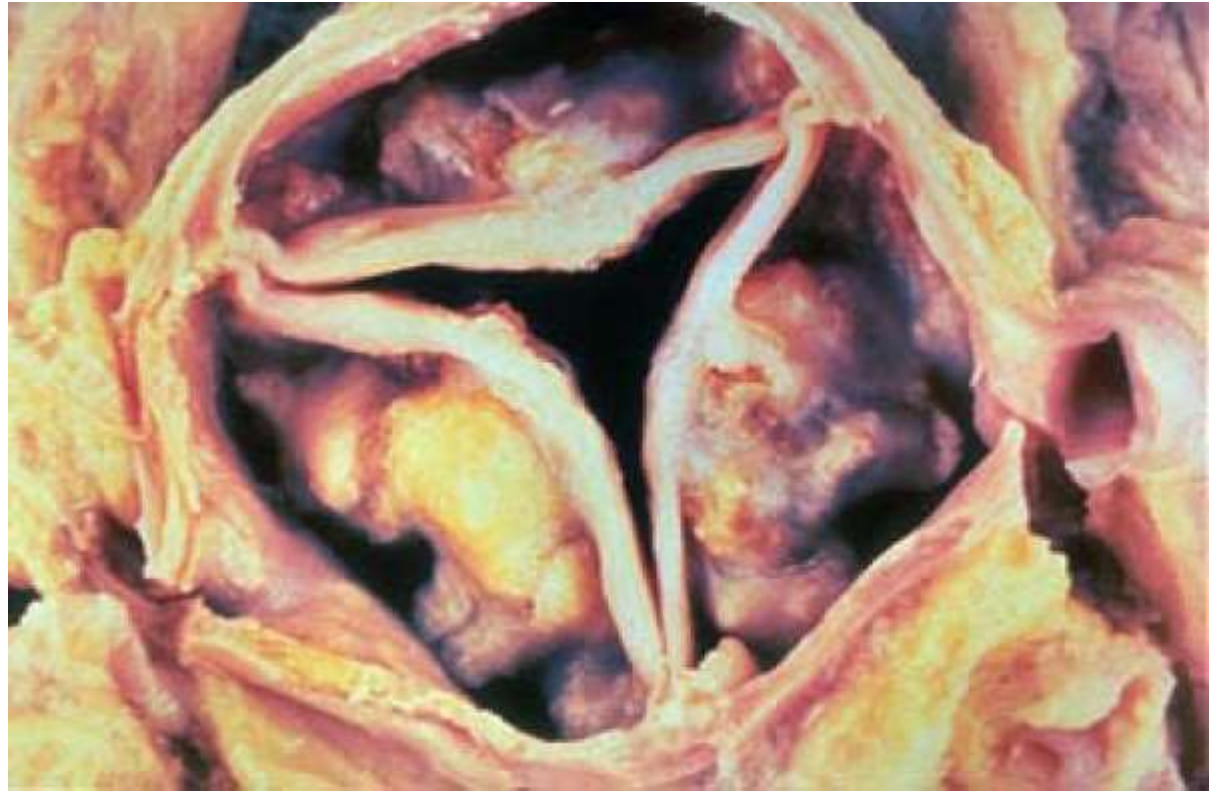


Principal elements of the heart's fibrous skeleton



Acquired valvular heart defects: causes and risk factors

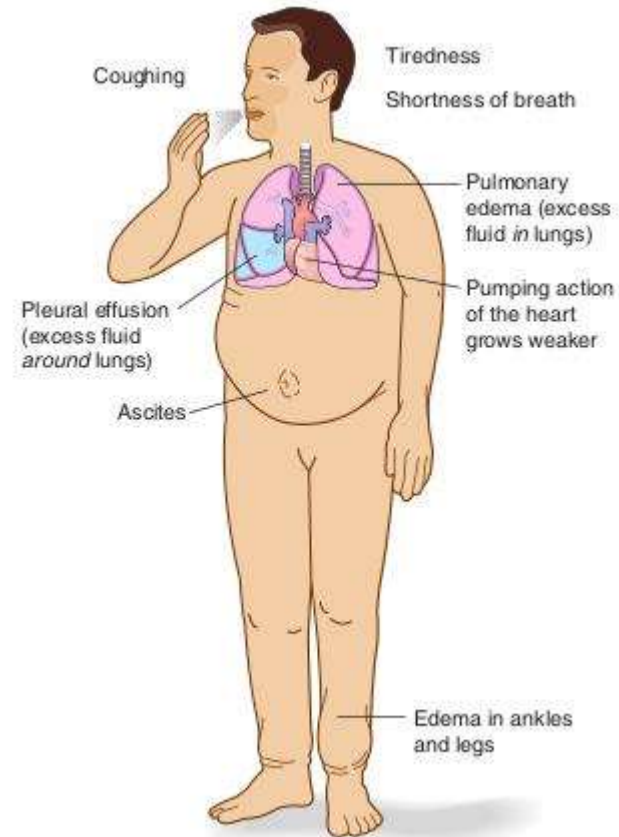
- Age
- Heart attack
- Heredity
- Calcium deposits
- Endocarditis
- Rheumatic fever
- High blood pressure
- Cardiomyopathy
- Connective tissue diseases



Calcified aortic valves

Acquired valvular heart defects: common symptoms

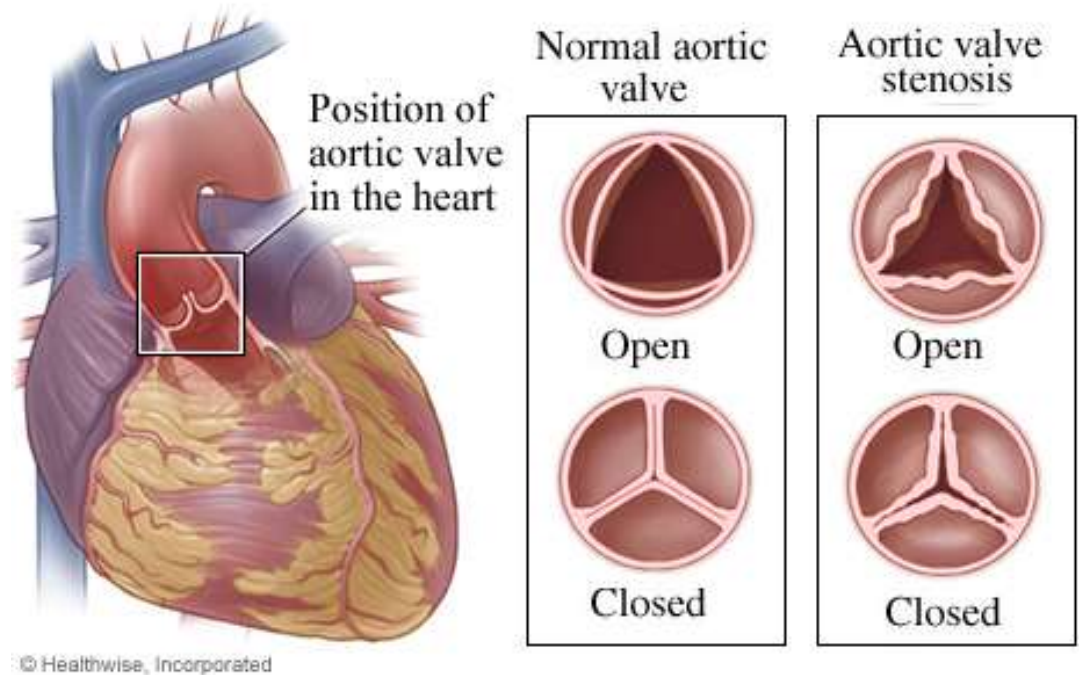
- Shortness of breath
- Weakness
- Dizziness
- Discomfort in chest
- Palpitations
- Edema



Aortic valve stenosis

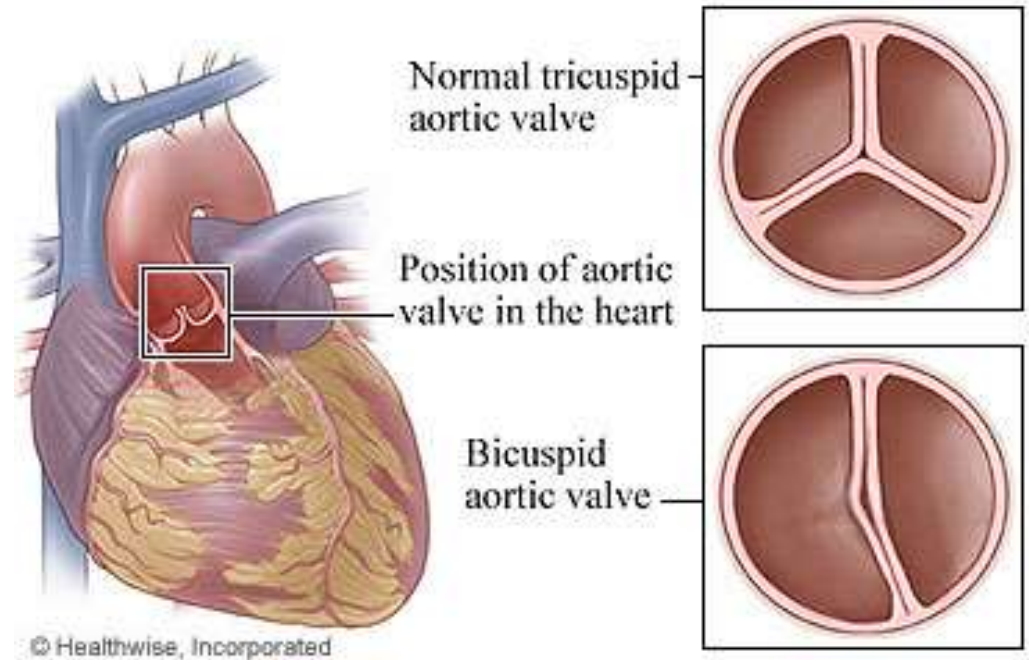
Aortic valve stenosis: definition, classification

- Aortic valve stenosis (aortic stenosis) is the most common type of acquired valvular heart defects that requires valve replacement
- Aortic valve stenosis can be classified according to the anatomical location: supraaortic, valvular and subvalvular



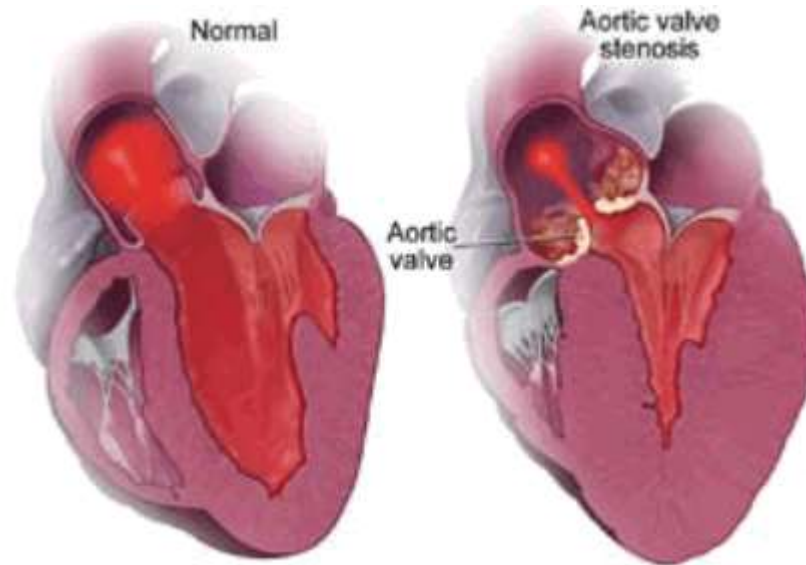
Aortic valve stenosis: causes, risk factors

- The causes of aortic valve disease include bicuspid aortic valve, degenerative aortic valve disease, rheumatic heart disease, atherosclerotic aortic disease, etc.
- Risk factors are closely associated with atherosclerosis including diabetes, smoking, hypertension and dyslipidemia



Bicuspid aortic valve

Aortic valve stenosis: heart changes



**Normal and aortic stenosis' hearts:
find difference**

Aortic valve stenosis: signs and symptoms: classic triad

- Chest pain: angina pectoris in patients with aortic stenosis is typically precipitated by exertion and relieved by rest
- Heart failure: symptoms include paroxysmal nocturnal dyspnea, orthopnea, dyspnea on exertion, and shortness of breath
- Syncope: often occurs upon exertion when systemic vasodilatation in the presence of a fixed forward stroke volume causes the arterial systolic blood pressure to decline



Aortic valve stenosis: signs and symptoms: other

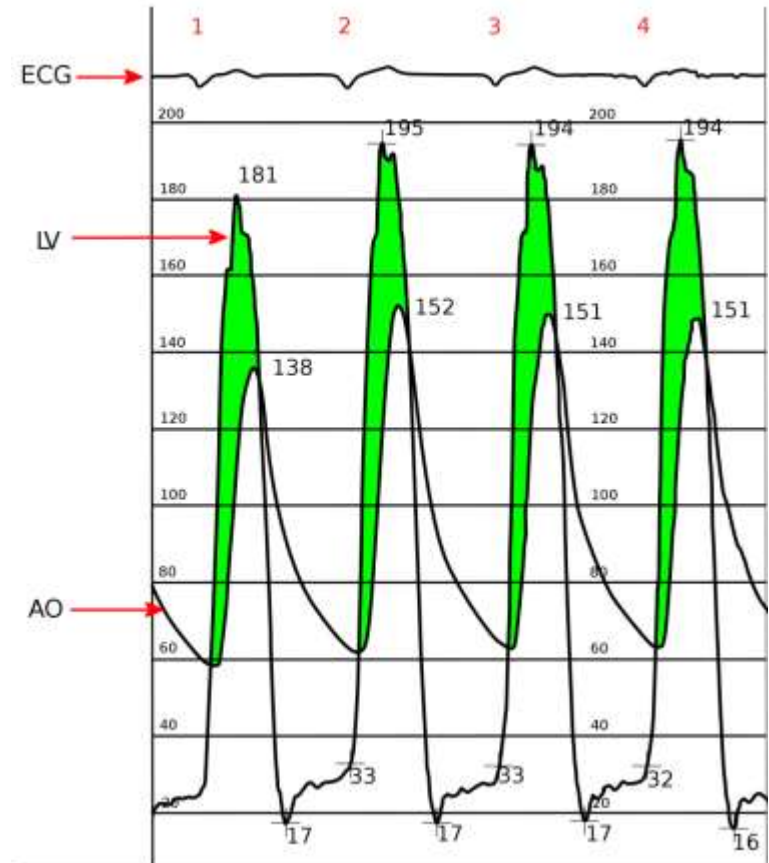
- Systolic hypertension
- Low values of systolic and pulse blood pressure
- Pulsus alternans
- Hyperdynamic left ventricle
- Soft or normal S1, diminished or absent A2, paradoxical splitting of the S2, accentuated P2, ejection click, prominent S4, the classic crescendo-decrescendo systolic murmur

The murmur of aortic regurgitation

Mild aortic regurgitation



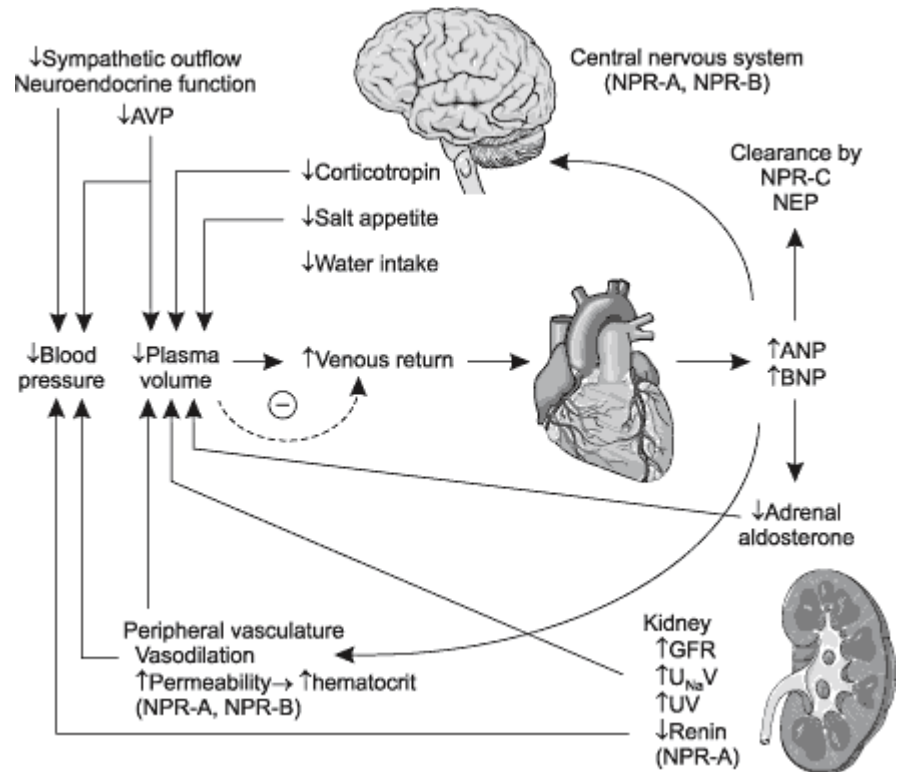
Severe aortic regurgitation



Pressure gradient between the left ventricle and aorta, suggesting aortic stenosis

Aortic valve stenosis: selected laboratory studies

- Serum electrolyte levels
- Cardiac biomarkers
- Complete blood count
- B-type natriuretic peptide:
May provide incremental prognostic information for predicting symptom onset in asymptomatic patients with severe aortic stenosis



**The effects of B-type natriuretic peptide (BNP)
on target organs**

Aortic valve stenosis: instrumental studies

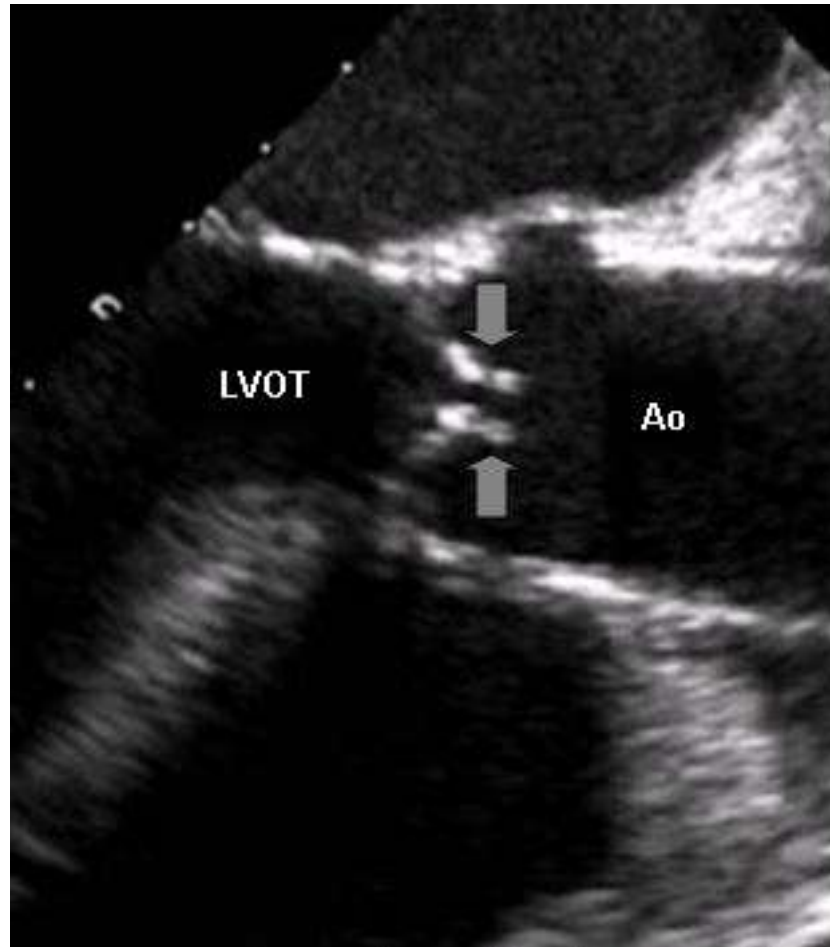
- Chest X-ray
- Electrocardiogram
- Echocardiogram
- Exercise electrocardiogram
- Cardiac MRI
- Cardiac catheterization
- Radionuclide ventriculography

Parameters	Slight	Moderate	Severe
PG max	15-40 mmHg	40-70 mmHg	70-100 mmHg (> 100 mmHg severe AoS)
PG mean	<20mmHg	20-40mmHg>	40mmHg
AVA>	1.5cm ²	1.5-1cm ²	<1cm ²
Dimensionless index>	0.50	0.25 to 0.50	<0.25
Vmax	<3m/s	3-4m/s	>4m/s
AVA BSAindex	>0.85cm ² /m ²	0.85- 0.60cm ² /m ²	<0.60cm ² /m ²

Aortic stenosis quantification

<http://radiopaedia.org/articles/aortic-valve-stenosis>

Aortic valve stenosis: B-mode echocardiography



Transoesophageal echocardiogram of a severely stenotic aortic valve

Aortic valve stenosis: B-mode echocardiography



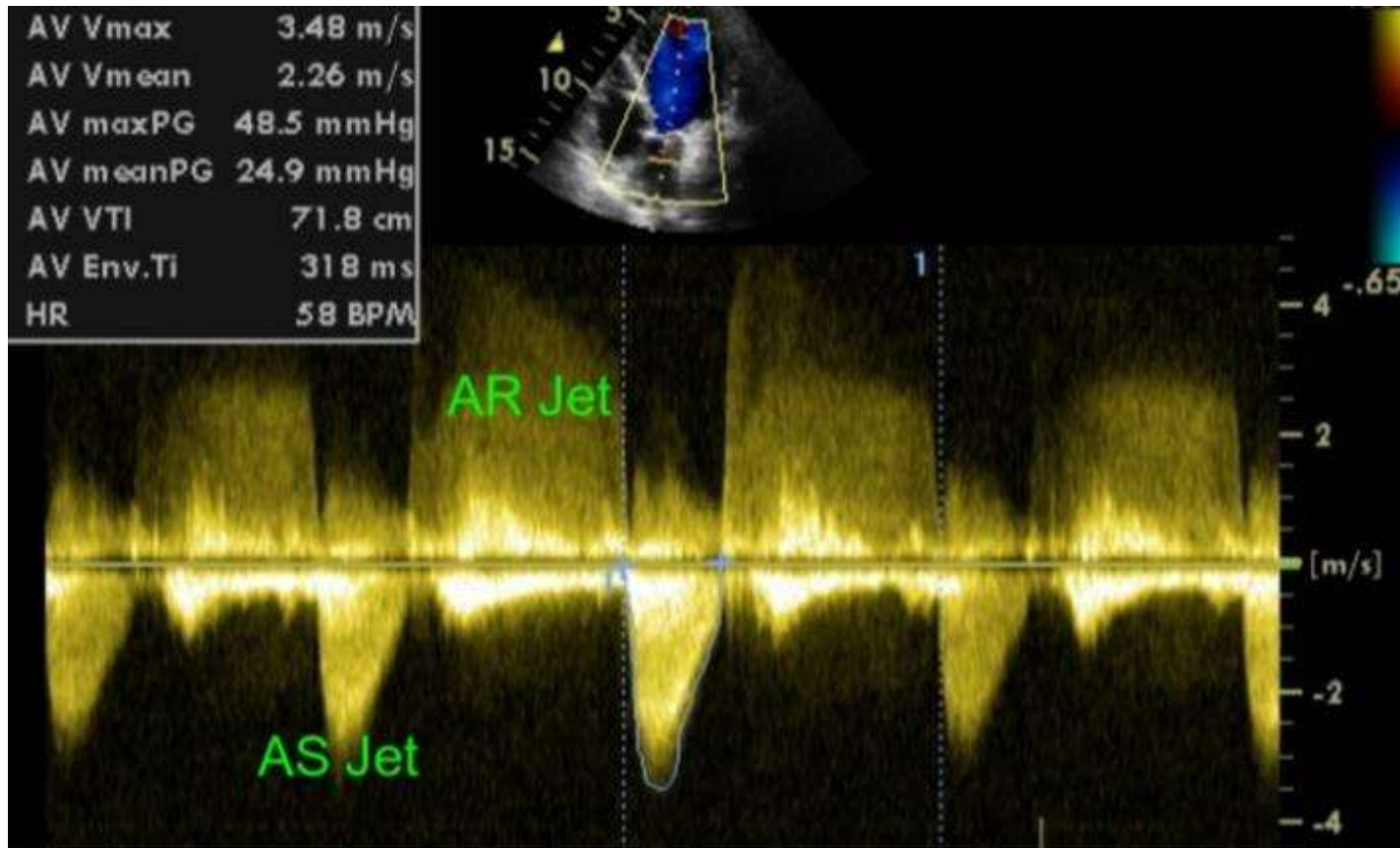
Severe Aortic Stenosis

Aortic valve stenosis: B-mode echocardiography



Echocardiography for transcatheter aortic valve implantation

Aortic valve stenosis: Doppler echocardiography



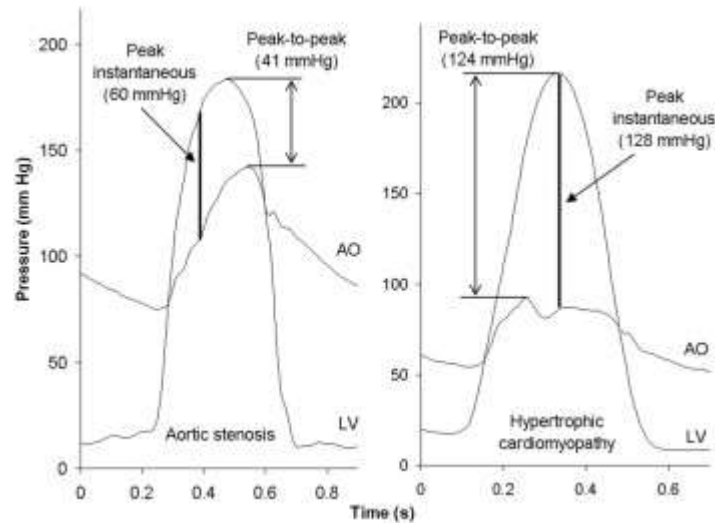
Aortic stenosis gradient

Aortic valve stenosis: computer tomography



The effects of B-type natriuretic peptide (BNP) on target organs

Aortic valve stenosis: cardiac catheterization




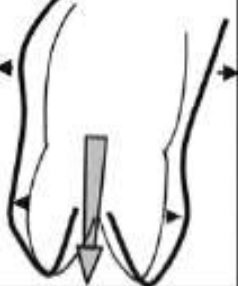
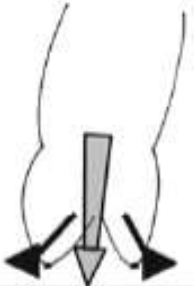



Assessment of Left Ventricular Outflow Gradient

Aortic valve insufficiency/regurgitation

Aortic valve insufficiency/regurgitation: definition, types, causes

- Aortic insufficiency/ regurgitation (AI) is the leaking of the aortic valve of the heart that causes blood to flow in the reverse direction during ventricular diastole, from the aorta into the left ventricle
- Types: acute, chronic
- About half of the cases of AI are due to the aortic root dilation, which is idiopathic in over 80% of cases, but otherwise may result from aging, syphilitic aortitis, osteogenesis imperfecta, aortic dissection, Behçet's disease, reactive arthritis and systemic hypertension
- In about 15% the cause is innate bicuspidal aortic valve, while another 15% cases are due to retraction of the cusps as part of postinflammatory processes of endocarditis in rheumatic fever/infective endocarditis and various collagen vascular diseases
- AI has been linked to the use of some medications (fenfluramine, dexfenfluramine isomers, dopamine agonists, etc.)
- Other potential causes include Marfan's syndrome, Ehlers–Danlos syndrome, ankylosing spondylitis, etc.

Aortic valve insufficiency/regurgitation: types of causes

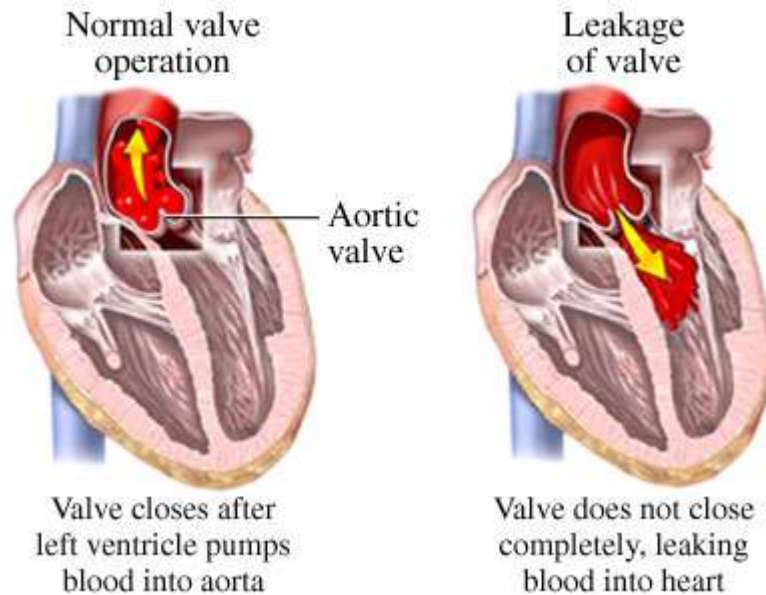
AI Class	Type I Normal cusp motion with FAA dilatation or cusp perforation				Type II Cusp Prolapse	Type III Cusp Restriction
	Ia	Ib	Ic	Id		
Mechanism						

Functional classification of aortic insufficiency (AI) with
description of disease mechanisms

Aortic valve insufficiency/regurgitation: pathophysiology

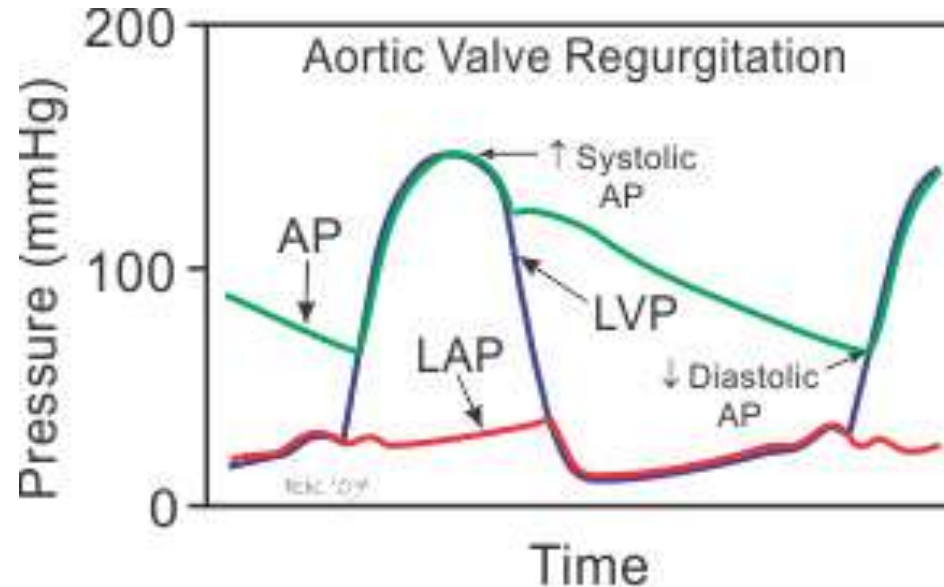
- In aortic insufficiency (AI), when the pressure in the left ventricle falls below the pressure in the aorta, the aortic valve is not able to completely close, and this causes a leaking of blood from the aorta back into the left ventricle (*regurgitating*)
- The percentage of blood that regurgitates back through the aortic valve due to AI is known as the regurgitant fraction
- The regurgitant flow causes a decrease in the diastolic blood pressure in the aorta, and therefore an increase in the pulse pressure
- While diastolic blood pressure is diminished and the pulse pressure widens, systolic blood pressure generally remains normal or can even be slightly elevated because sympathetic nervous system and the renin-angiotensin-aldosterone axis compensate for the decreased cardiac output
- The volume overload causes left ventricular hypertrophy (LVH) and dilation

Aortic valve insufficiency/regurgitation: heart changes



**Normal and aortic insufficiency/regurgitation' hearts:
find difference**

Aortic valve insufficiency/regurgitation: main hemodynamics disturbances



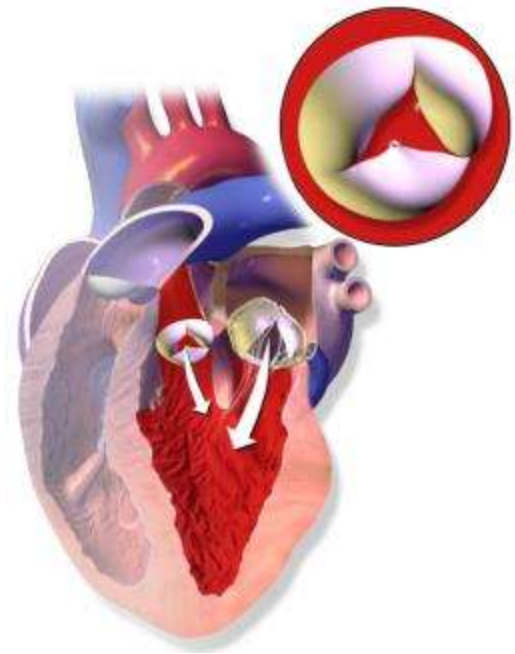
During ventricular relaxation, blood flows backwards from aorta into the ventricle. Aortic systolic pressure increases, aortic diastolic pressure decreases, and pulse pressure increases; LAP increase.

Abbreviations: LAP, left atrial pressure; LVP, left ventricular pressure; AP, aortic pressure.

The changes in aortic pressure (AP), left ventricular pressure (LVP) and left atrial pressure (LAP)

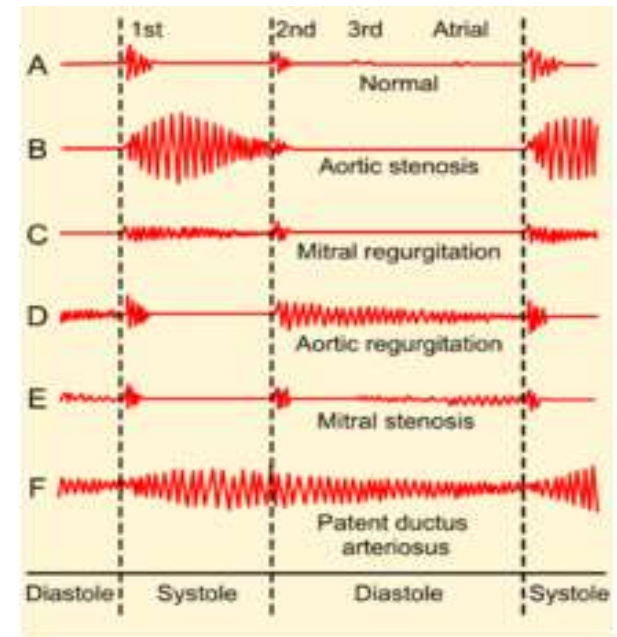
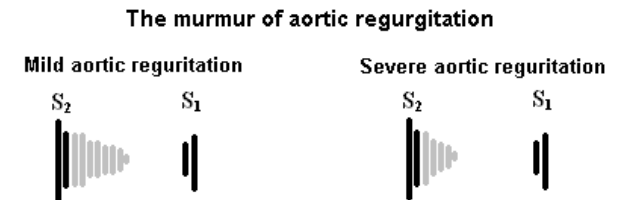
Aortic valve insufficiency/regurgitation: symptoms

- Dyspnea on exertion
- Orthopnea
- Paroxysmal nocturnal dyspnea
- Palpitations
- Heart murmur
- Angina pectoris
- Fatigue
- Weakness
- Swollen ankles and feet (edema)
- Lightheadedness or fainting
- Cyanosis
- Circulatory shock



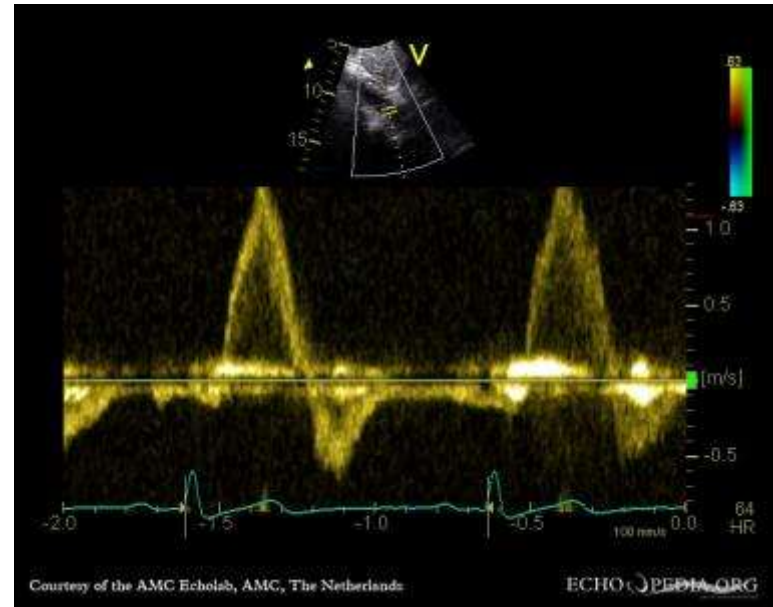
Aortic valve insufficiency/regurgitation: physical examination

- Heart murmur that can be heard through a stethoscope
- Very forceful beating of the heart
- Bobbing of the head in time with the heartbeat
- Hard pulses in the arms and legs
- Low diastolic blood pressure
- Signs of fluid in the lungs



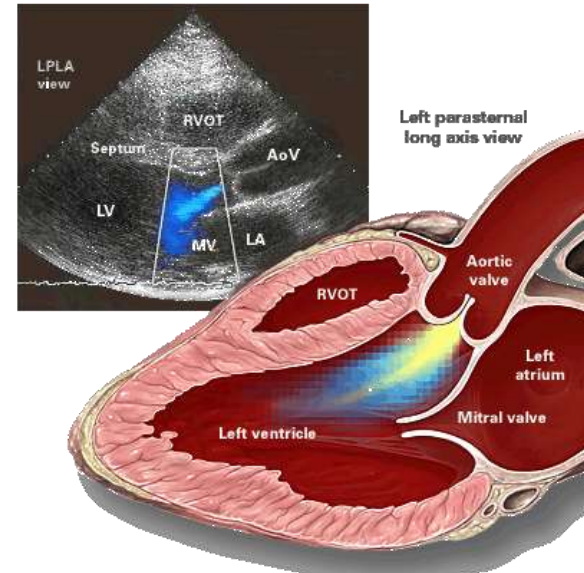
Aortic valve insufficiency/regurgitation: diagnostic tests

- Echocardiography
- Stress tests
- Cardiac magnetic resonance imaging
- Electrocardiography (ECG) .
- Chest X-ray
- Cardiac catheterization



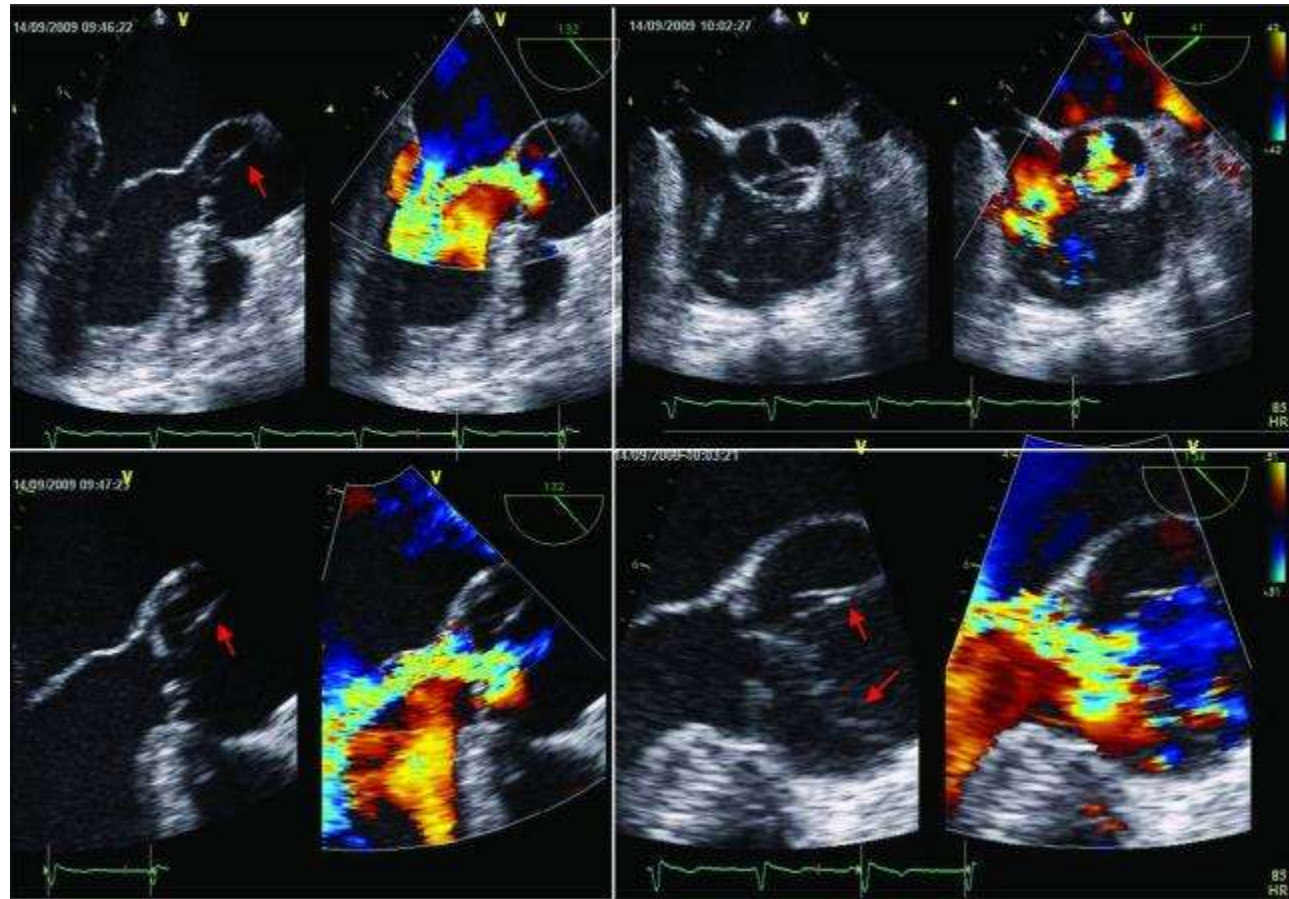
Aortic valve insufficiency/regurgitation: echocardiography

- The severity of aortic regurgitation is estimated using three parameters on echocardiography:
- Regurgitant jet size
- Pressure half-time
- Regurgitant fraction



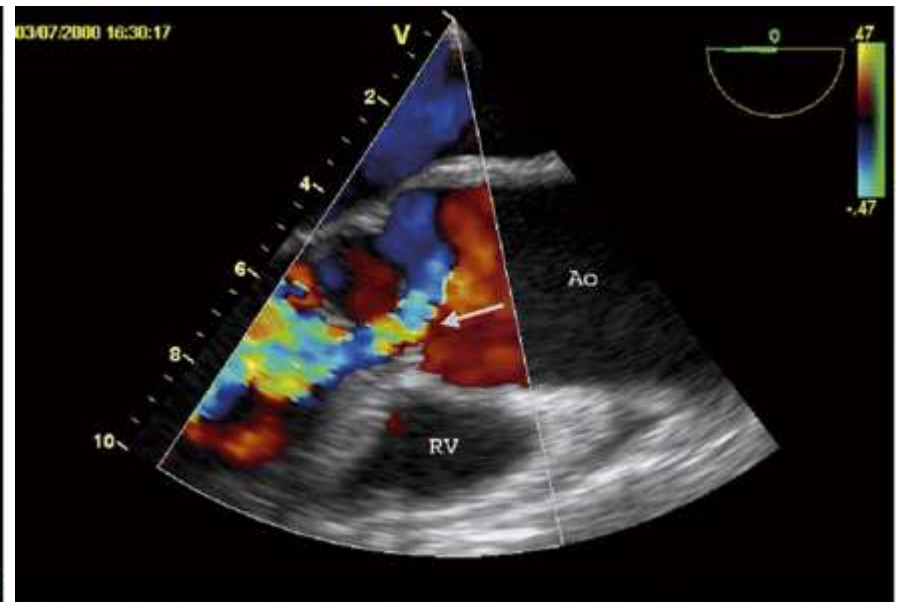
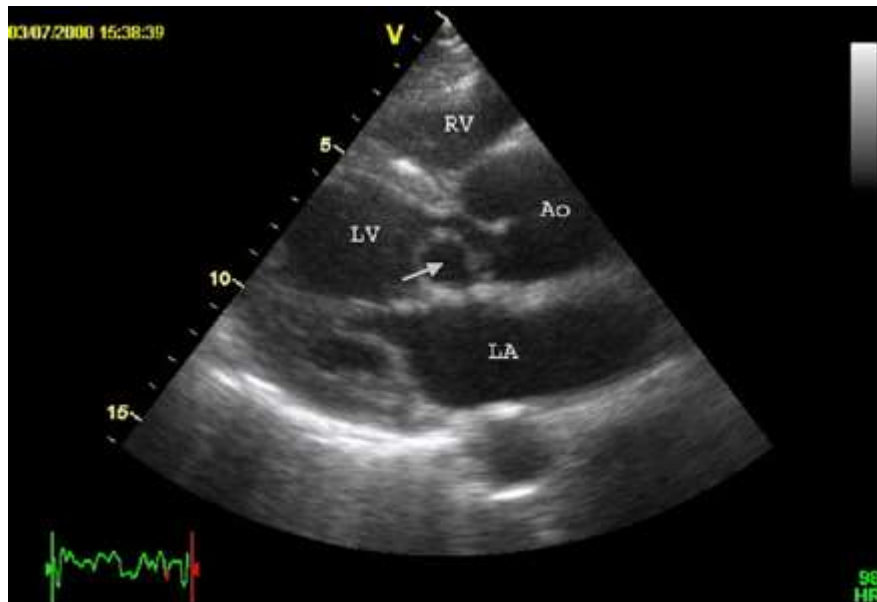
Severity	Jet Size Ratio	Pressure Half-Time	Regurgitant Fraction (%)
Mild	<24	>500	<20
Moderate	25-45	500-349	20-35
Moderate-severe	46-64	349-200	56-50
Severe	> 65	< 200	> 50

Aortic valve insufficiency/regurgitation: echocardiography



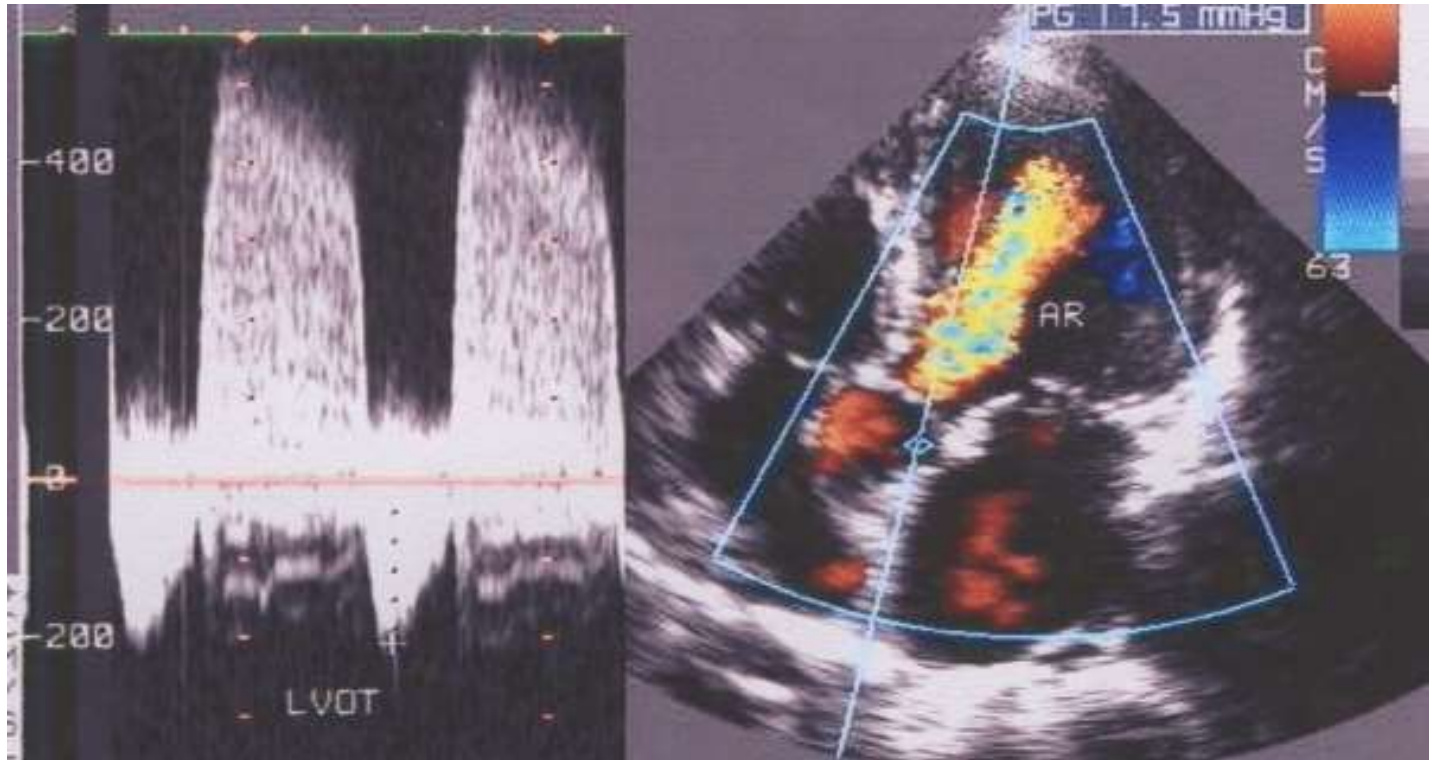
Transesophageal echocardiography showing the chordae tendineae strands (arrows) connecting a mildly dilated aortic root to sigmoid cusps that present tenting and restriction with a severe aortic regurgitation

Aortic valve insufficiency/regurgitation: echocardiography



Aortic valve regurgitation due to cusp aneurysm

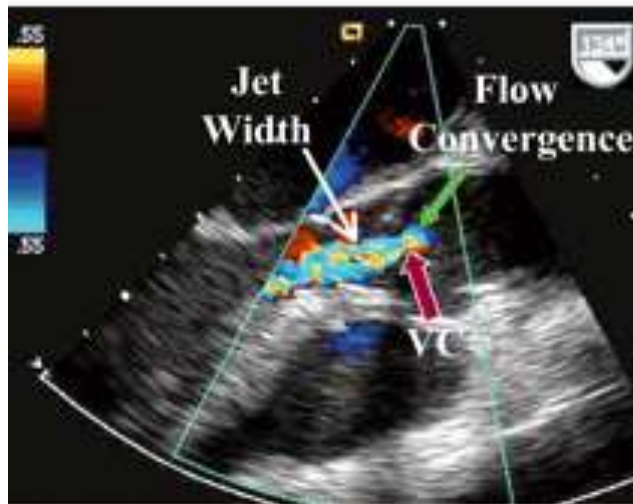
Aortic valve insufficiency/regurgitation: echocardiography



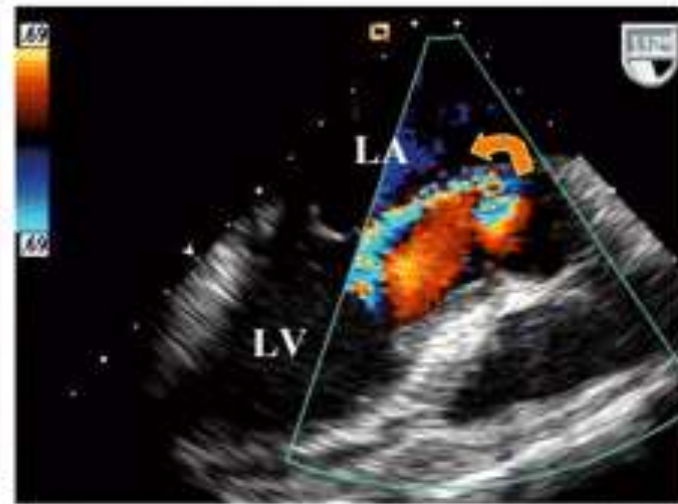
Aortic regurgitation (multicoloured mosaic jet seen in left ventricle)

Aortic valve insufficiency/regurgitation: echocardiography

Central AR Jet

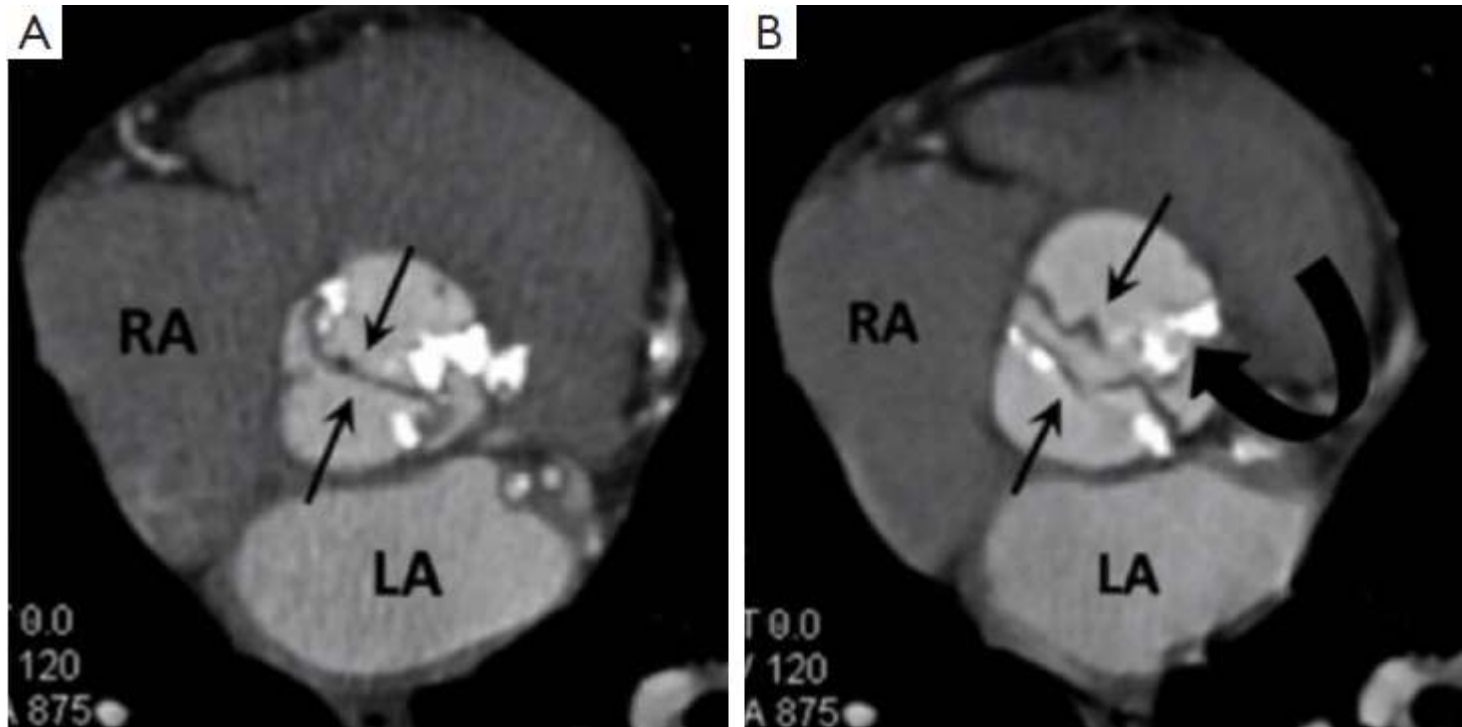


Eccentric AR Jet



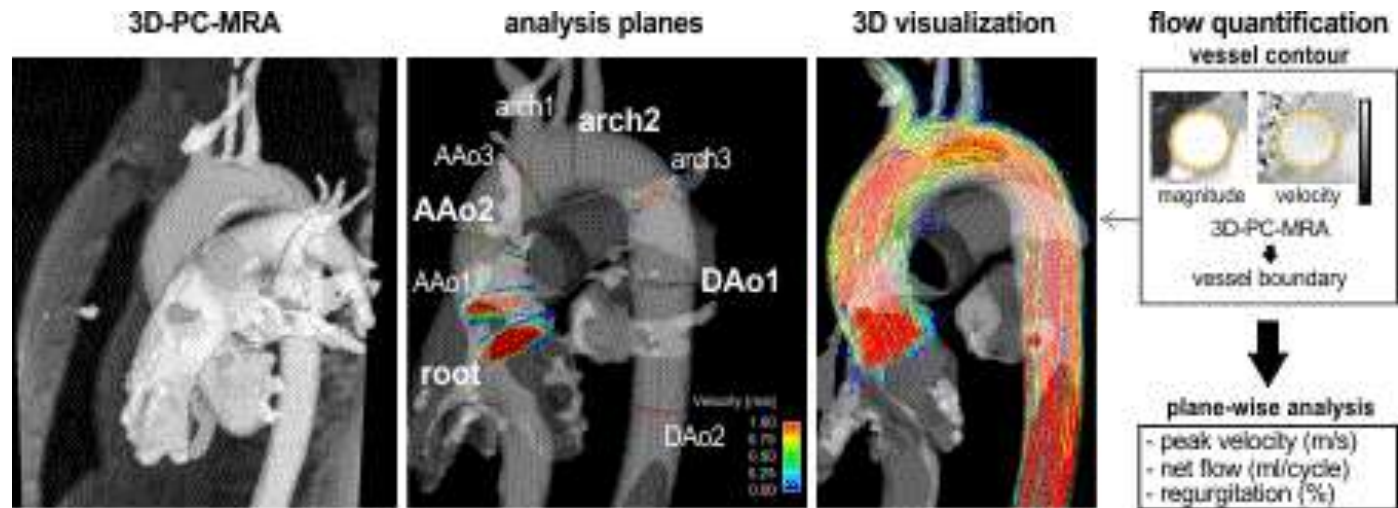
Examples of central and eccentric aortic regurgitation (AR) jets

Aortic valve insufficiency/regurgitation: cardiac magnetic resonance imaging



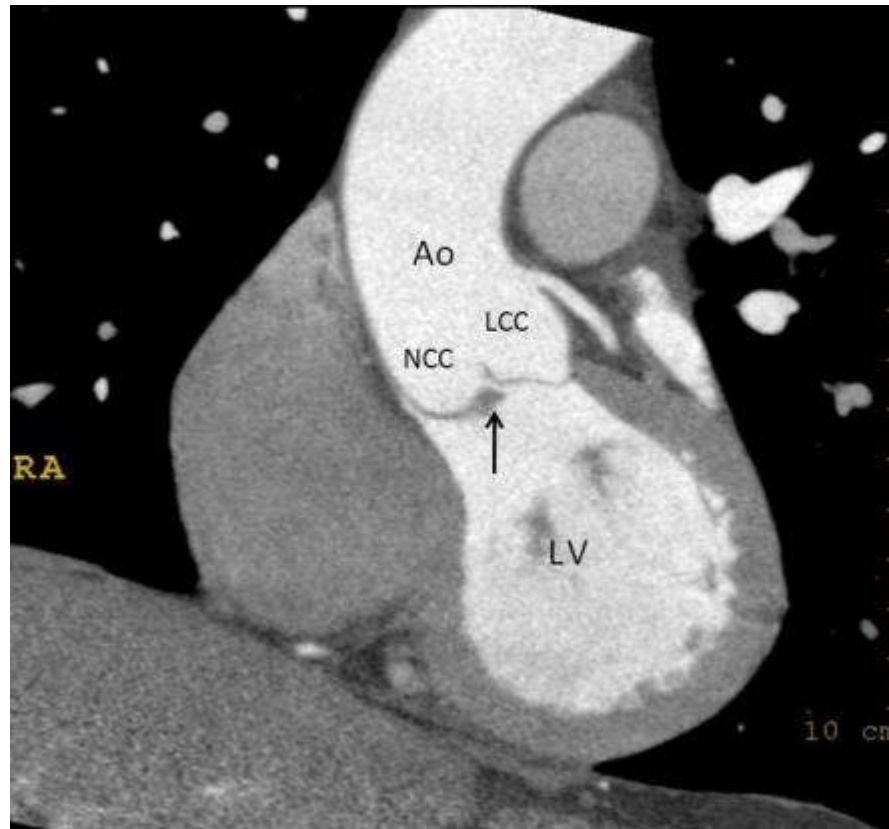
BAV in a 35-year-old man. (A) Cross sectional CT reconstruction through the aortic valve plane in diastole showing an apparent single line of valve fusion (arrows) raising the possibility of a BAV. Note the heavy valvular calcification as a marker of degeneration; (B) cross sectional CT reconstruction through the aortic valve plane in systole showing an elliptical “fishmouth” opening pattern in keeping with a BAV. Calcification can be seen along the line of left and right cusp fusion (curved arrow). BAV, bicuspid aortic valve; LA, left atrium; RA, right atrium.

Aortic valve insufficiency/regurgitation: cardiac magnetic resonance imaging



4D flow MRI-based analysis of aortic hemodynamics can be performed with good reproducibility and accuracy using a new faster and semi-automated workflow

Aortic valve insufficiency/regurgitation: computed tomography



Arrow points to vegetation below non-coronary cusp (NCC). Vegetation measures 10 x 6mm in this view. NB: the two aortic valve cusps fail to meet in this diastolic (75% R-R) image consistent with aortic regurgitation.

Aortic valve insufficiency/regurgitation: stress tests

Parameters	Baseline	20µg/kg/min	P
HR (bpm)	74.5±12.2	94.2±18.0	<0.001
EF (%)	62.3±7.9	71.5±10.5	<0.001
mG (mmHg)	6.8±2.5	14.7±9.3	<0.001

Bpm - beats per minute, HR - heart rate; EF - ejection fraction, mG - mean aortic gradient; min - minutes.

Dobutamine-stress echocardiography

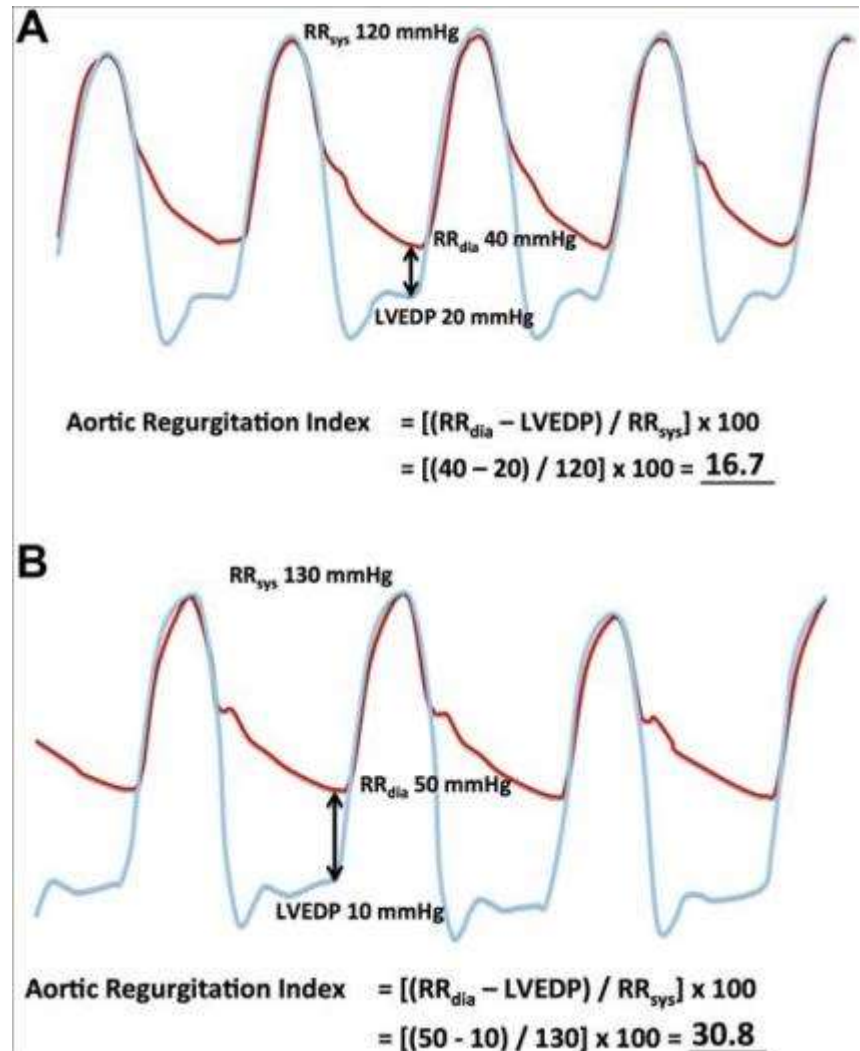
Aortic valve insufficiency/regurgitation: chest X-ray



**A Case of Severe Aortic Valve Regurgitation Caused by an Ascending Aortic Aneurysm
in a Young Patient With Autosomal Dominant Polycystic Kidney Disease and Normal
Renal Function**

Aortic valve insufficiency/regurgitation: cardiac catheterisation

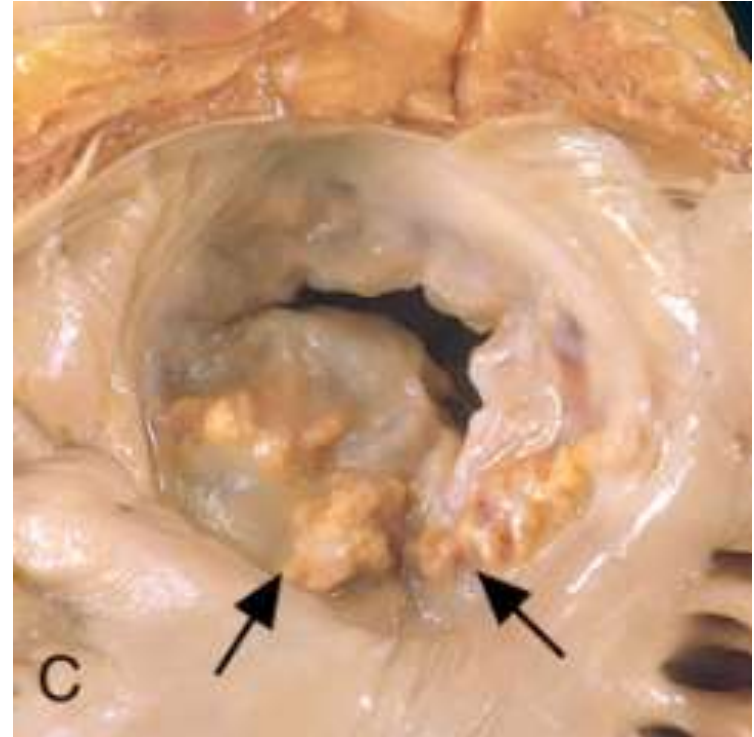
After adjustment for the systolic blood pressure level, the transvalvular gradient results in an ARI of 16.7 in a patient with moderate paravalvular aortic regurgitation PAR (A) and an ARI of 30.8 in a patient with trivial PAR(B). LVEDP = left-ventricular end-diastolic blood pressure; RR_{dia} = end-diastolic blood pressure in the aorta; RR_{sys} = systolic blood pressure in the aorta.



Mitral valve stenosis

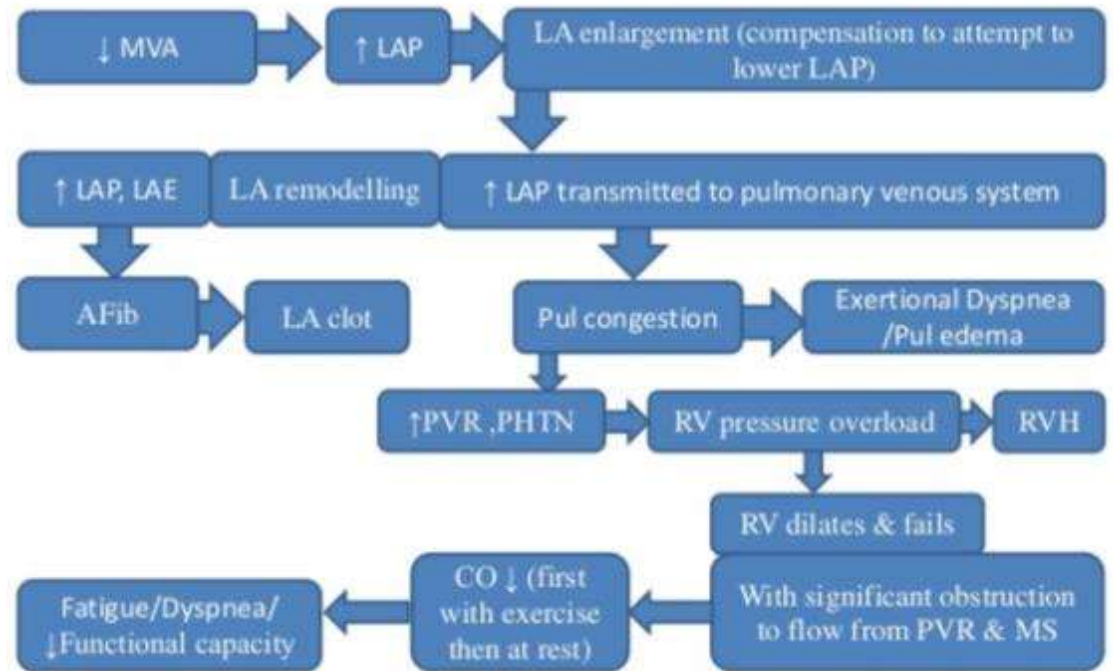
Mitral valve stenosis: definition, causes

- Mitral stenosis (MS) is characterized by obstruction to left ventricular inflow at the level of mitral valve due to structural abnormality of the mitral valve apparatus
- The most common cause of mitral stenosis is rheumatic fever
- Other, less common causes include malignant carcinoid disease, systemic lupus erythematosus, rheumatoid arthritis, mucopolysaccharidoses of the Hunter-Hurler phenotype, Fabry disease, Whipple disease, methysergide therapy, nonrheumatic mitral annular calcification, etc.



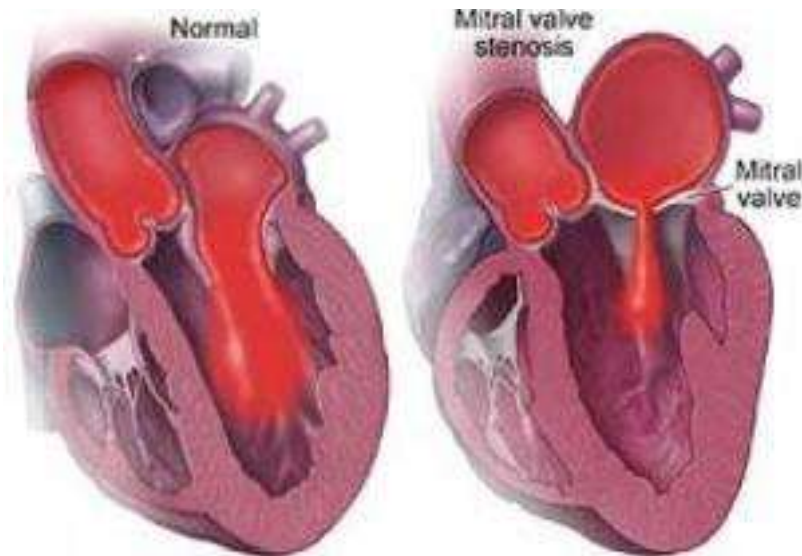
Mitral valve stenosis: pathophysiology

- The normal area of the mitral valve orifice is about 4 to 6 cm²
- Severity of stenosis is characterized echocardiographically as
 - Moderate: Valve area 1.5 to 2.5 cm²
 - Severe: Valve area < 1.5 cm²; symptoms are often present
 - Very severe: Valve area < 1.0 cm²



MVA –mitral valve area , **LAP** – left atrium pressure,
LAE – left atrium ejection, **PVR** - pulmonary vascular resistance,
PHTN - pulmonary hypertension, **RV** – right ventricle,
RVH - right ventricular hypertrophy, **CO** - carbon oxide

Mitral valve stenosis: heart changes



**Normal and mitral valve stenosis' hearts:
find difference**

Mitral valve stenosis: signs and symptoms

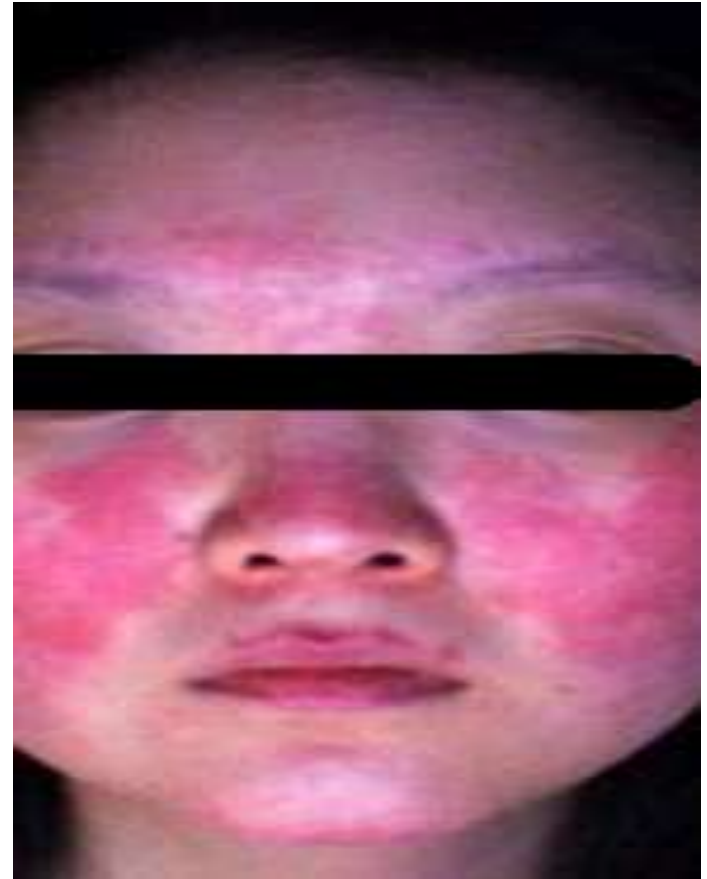
- Irregular pulse of atrial fibrillation
- Rise in jugular venous pressure (with coexistent tricuspid regurgitation)
- Parasternal heave with right ventricular hypertrophy
- Loud first heart sound
- Tapping apex beat (manifestation of a loud first heart sound)
- Opening snap, which disappears as the leaflets become rigid
- Classic late diastolic murmur with presystolic accentuation (the longer the murmur, the more severe the lesion)
- Shortness of breath
- Fatigue or weakness
- Paroxysmal nocturnal dyspnea (cardiac asthma)



Mitral valve stenosis:

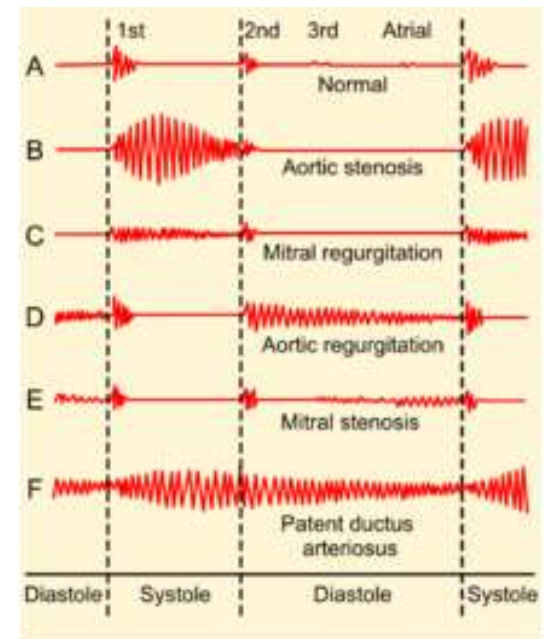
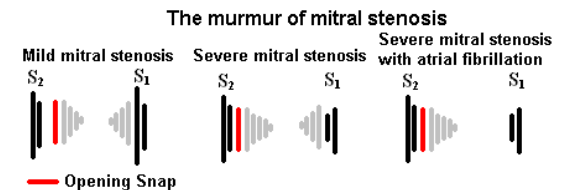
other less common signs and symptoms

- Hoarseness and vocal cord paralysis
- Trouble swallowing
- Chest pain
- Skin color changes, such as pink to purple shades on the cheeks or a dark blue color on the body from reduced blood flow, usually only in the end stages of the disease
- Coughing up blood (Hemoptysis)
- Thromboembolism in later stages when the left atrial volume is increased (i.e., dilation)
- Ascites and edema and hepatomegaly (if right-side heart failure develops)



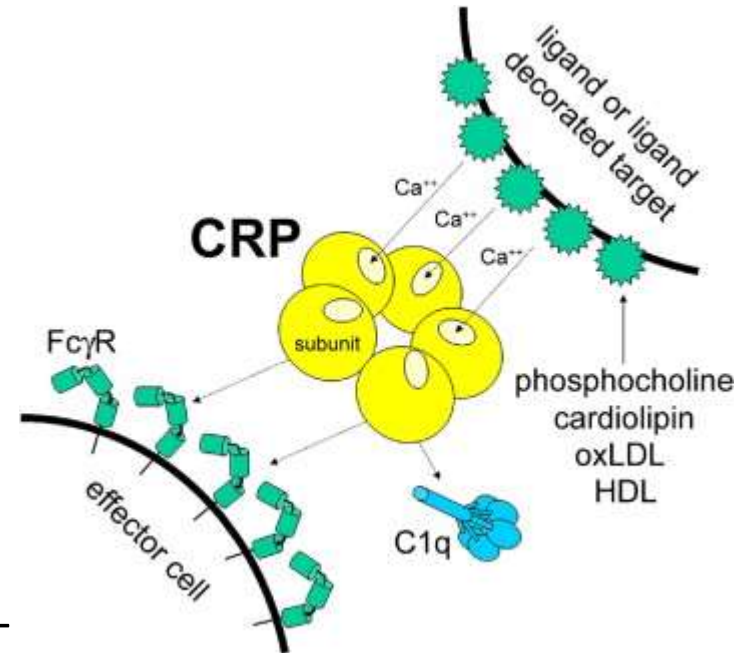
Mitral valve stenosis: physical examination

- Jugular venous distension due to rise in jugular venous pressure (with coexistent tricuspid regurgitation)
- Irregular pulse of atrial fibrillation
- Parasternal heave with right ventricular hypertrophy
- Tapping apex beat (manifestation of a loud first heart sound)
- Shift of heart dullness upward (left atrium) and to the right (right ventricle)
- The first heart sound is usually loud and may be palpable (tapping apex beat) because of increased force in closing the mitral valve
- If pulmonary hypertension secondary to mitral stenosis is severe, the pulmonic component of the second heart sound will become loud
- A mid-diastolic rumbling murmur with presystolic accentuation will be heard after the opening snap
- Signs of pulmonary hypertension
- Hepatomegaly
- Ascites



Mitral valve stenosis: selected laboratory studies

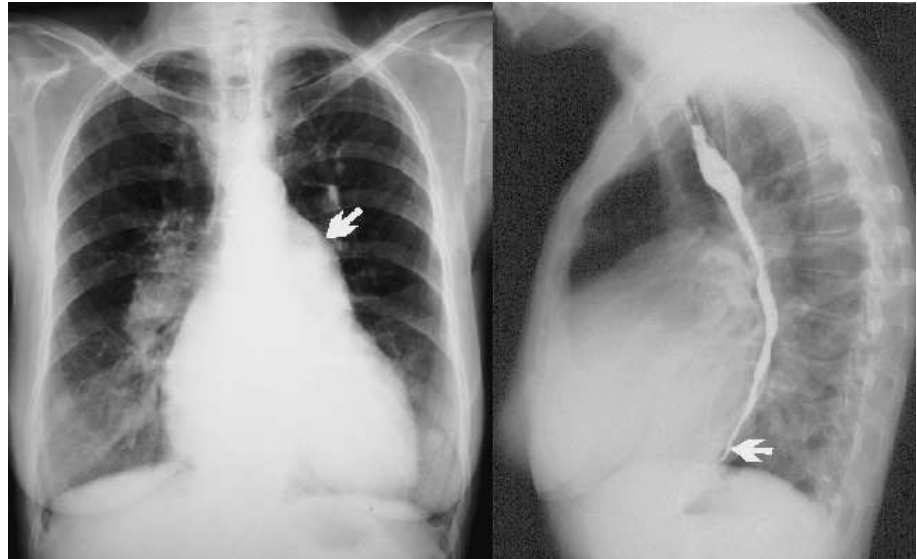
- Serum electrolyte levels
- Cardiac biomarkers
- Complete blood count
- Antistreptolysin O (ASLO) antibodies
- Renal and liver function tests
- Acute phase reactions: ESR / CRP / Leukocytosis
- Evidence of antecedent Strep. infection: ASO / Strep antibodies / Strep group A throat culture / Recent scarlet fever / anti-deoxyribonuclease B / anti-hyaluronidase
- Levels of antinuclear antibodies, etc.
- Assess for amyloid deposits in affected tissues



**The effects of B-type natriuretic peptide (BNP)
on target organs**

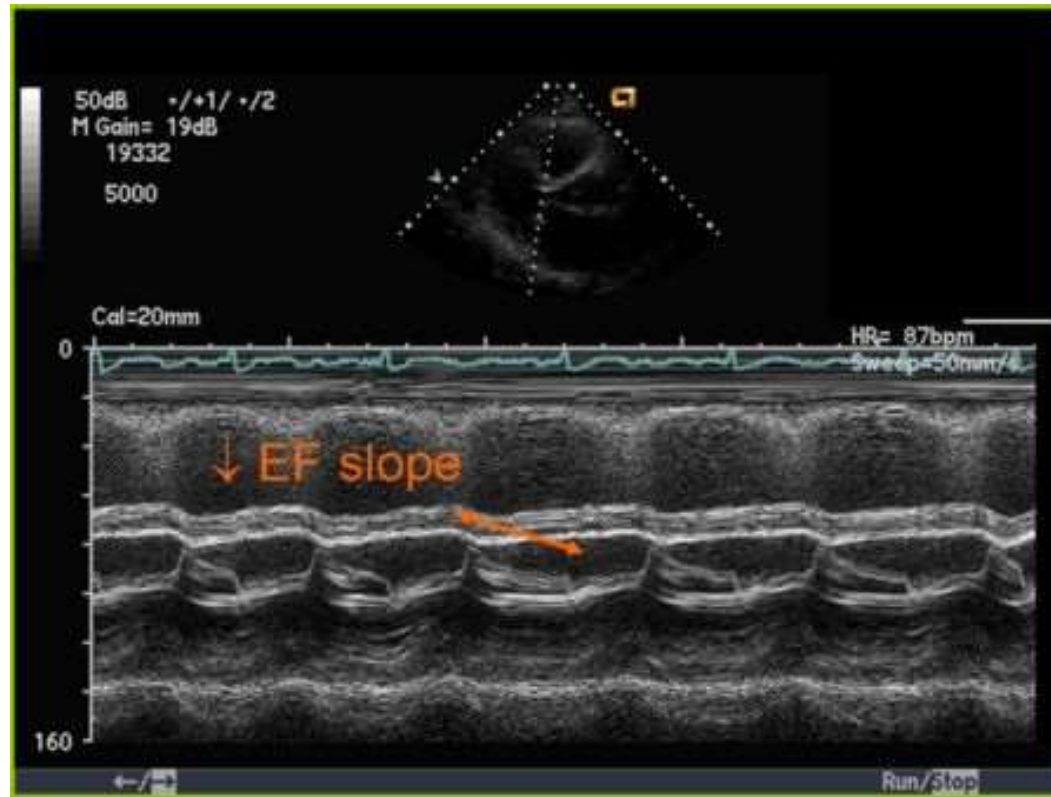
Mitral valve stenosis: instrumental studies

- Chest X-ray
- Electrocardiogram
- Echocardiogram
- Cardiac MRI
- Cardiac catheterization
- Radionuclide ventriculography



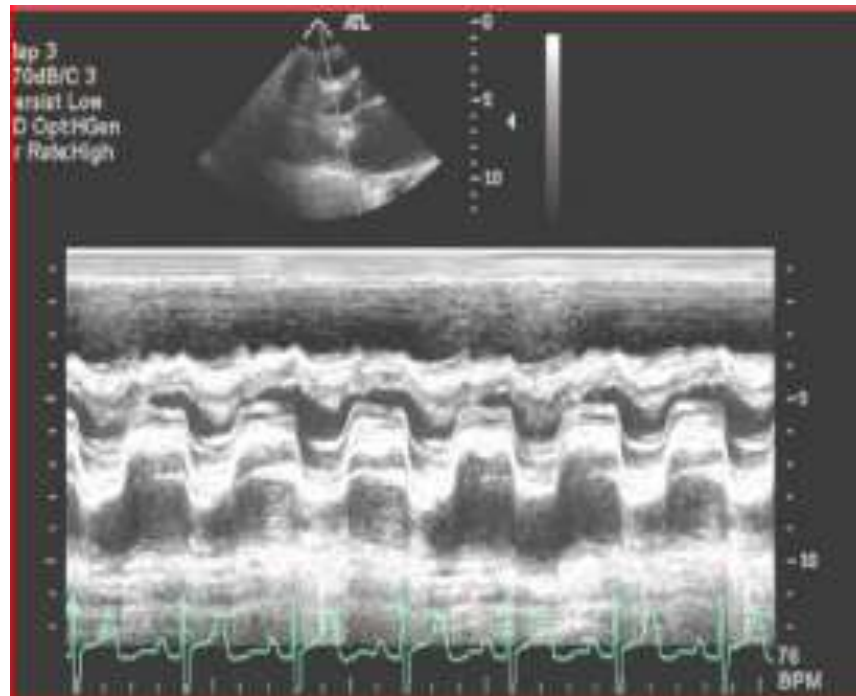
Mitral stenosis I

Mitral valve stenosis: M-mode echocardiography



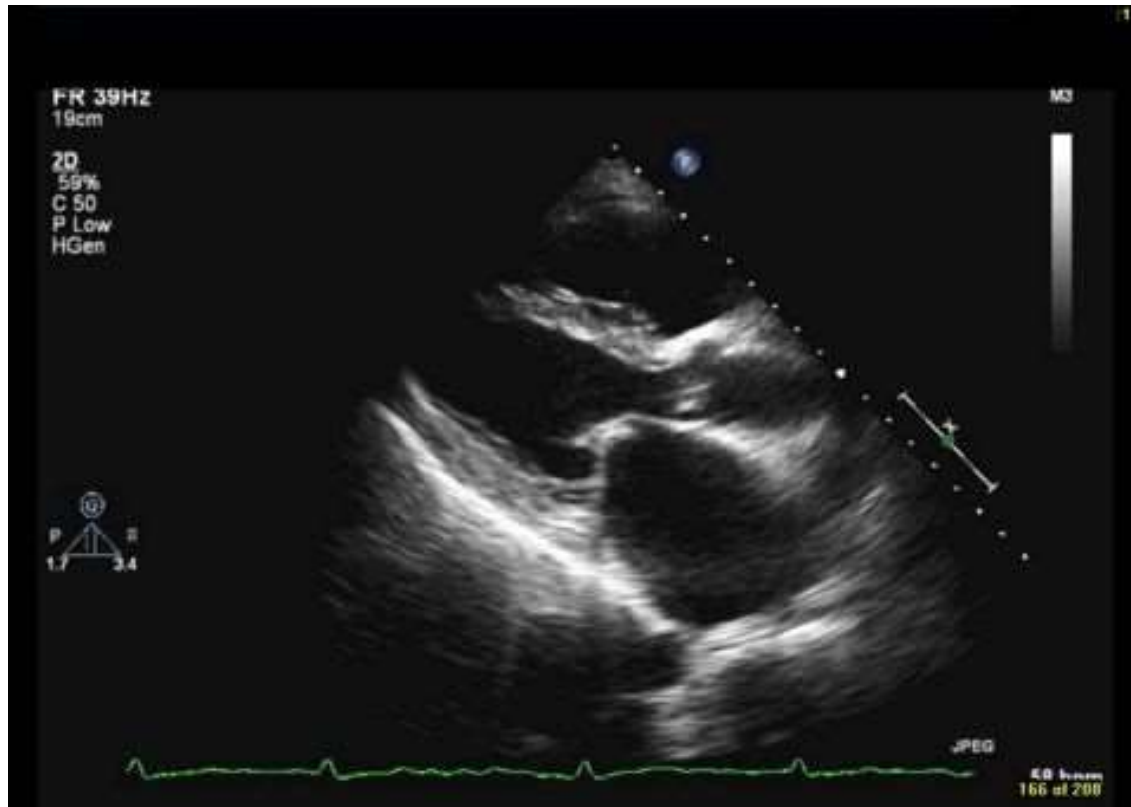
Mitral Stenosis M Mode

Mitral valve stenosis: M and B -mode echocardiography



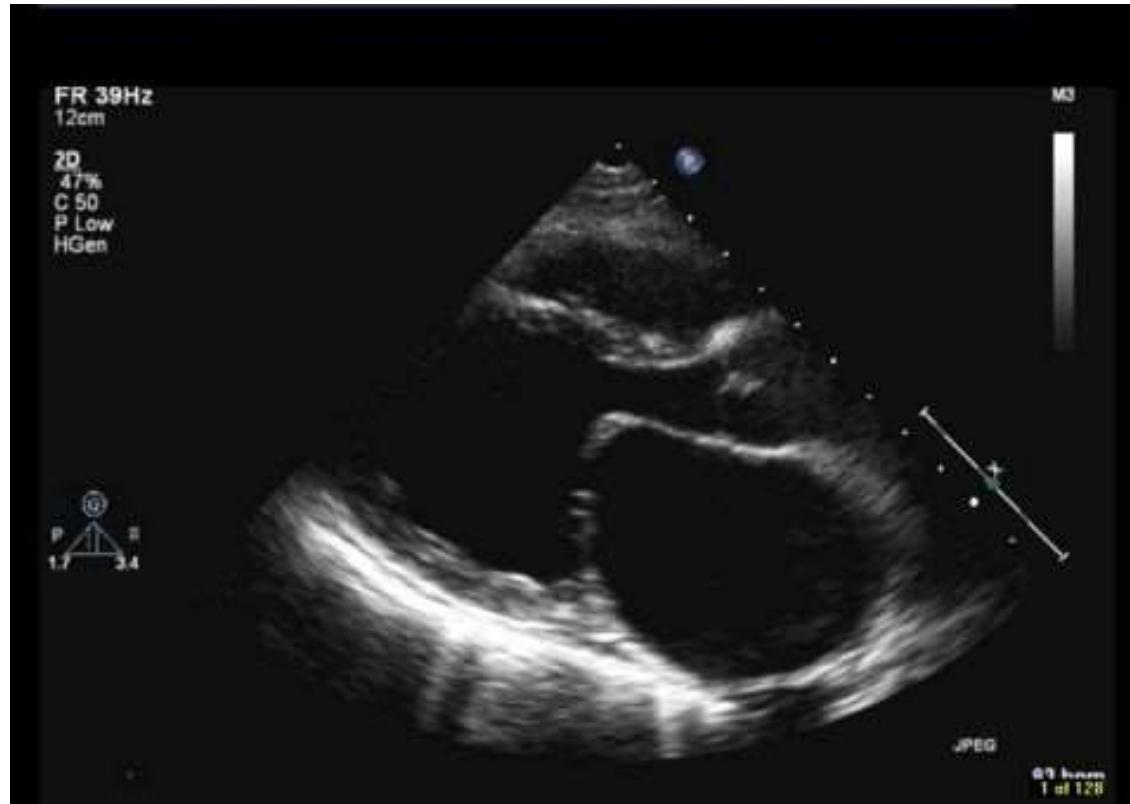
Hyperechogenicity of valvular leaflets and annulus together with calcification of supporting valvular structures

Mitral valve stenosis: B-mode echocardiography



There is thickening and fusion of the mitral valve commissural edges and chordae, which will result in a "doming" appearance of the mitral valve opening

Mitral valve stenosis: B-mode echocardiography



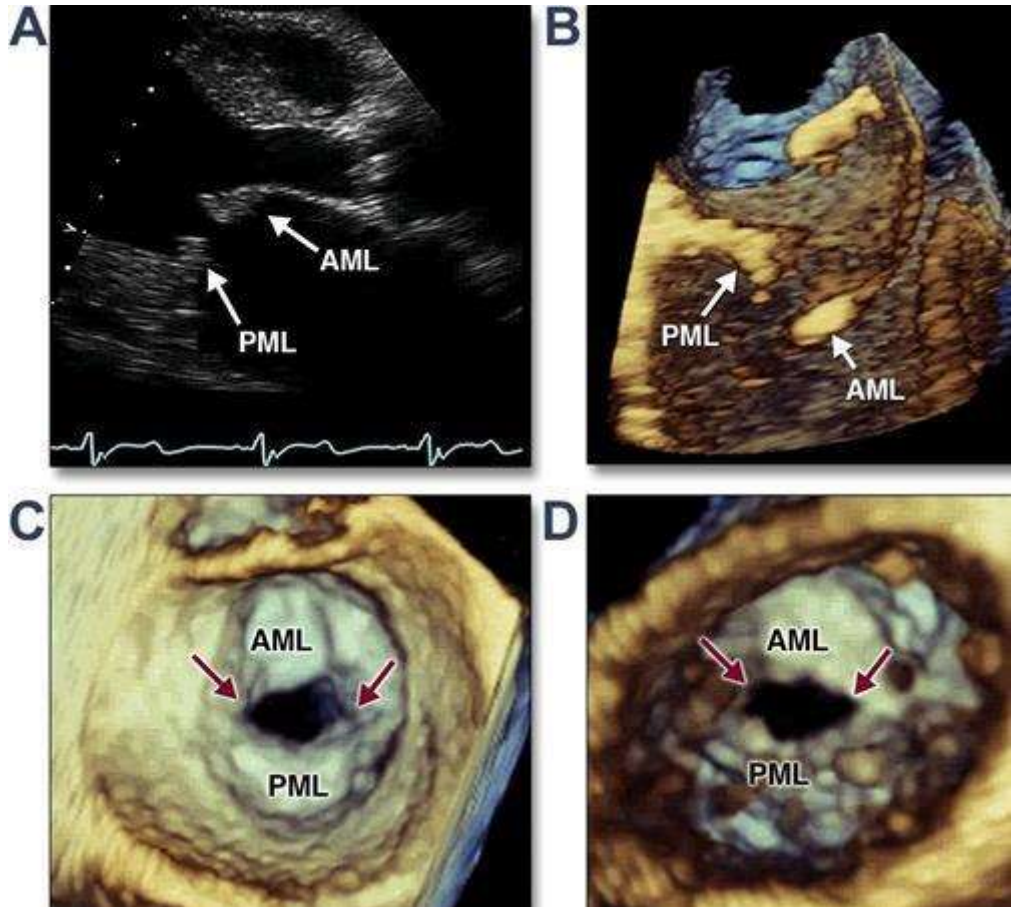
The anterior leaflet has been described as opening in a "hockey stick" appearance in parasternal long axis view

Mitral valve stenosis: B-mode echocardiography

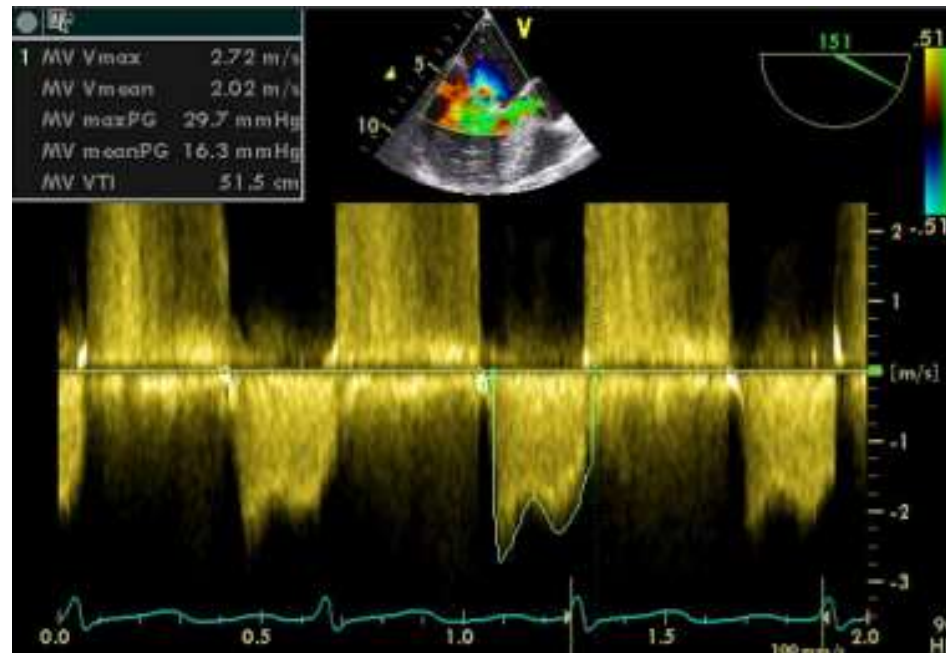
(A) Leaflet thickening at the edges is shown in a parasternal long axis transthoracic view.

(B) The immobility of the posterior leaflet and the doming of the anterior leaflet as typical morphological characteristics of rheumatic mitral valve disease are shown in a 3-dimensional transesophageal image. The 3-dimensional transesophageal images (left atrial aspect

[C]) and (left ventricular aspect **[D]**) show the fusion of both commissures (**red arrows**).
AML = anterior mitral leaflet;
PML = posterior mitral leaflet.

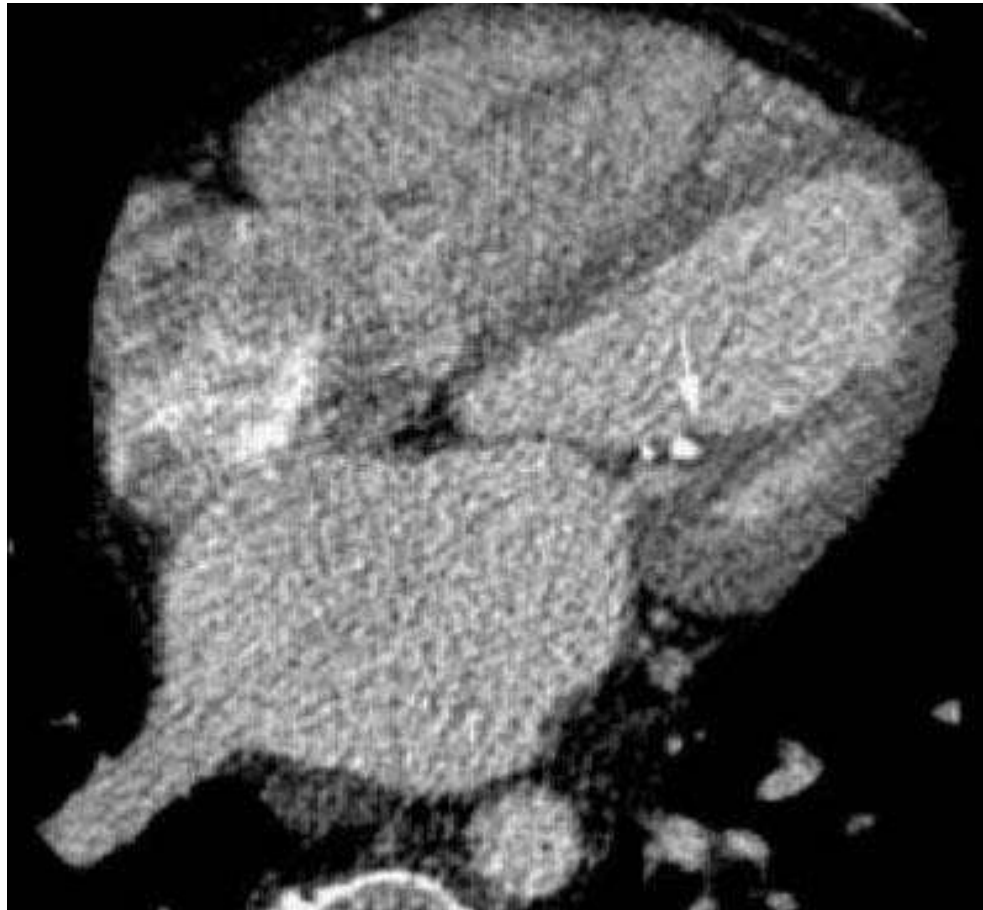


Mitral valve stenosis: Doppler echocardiography

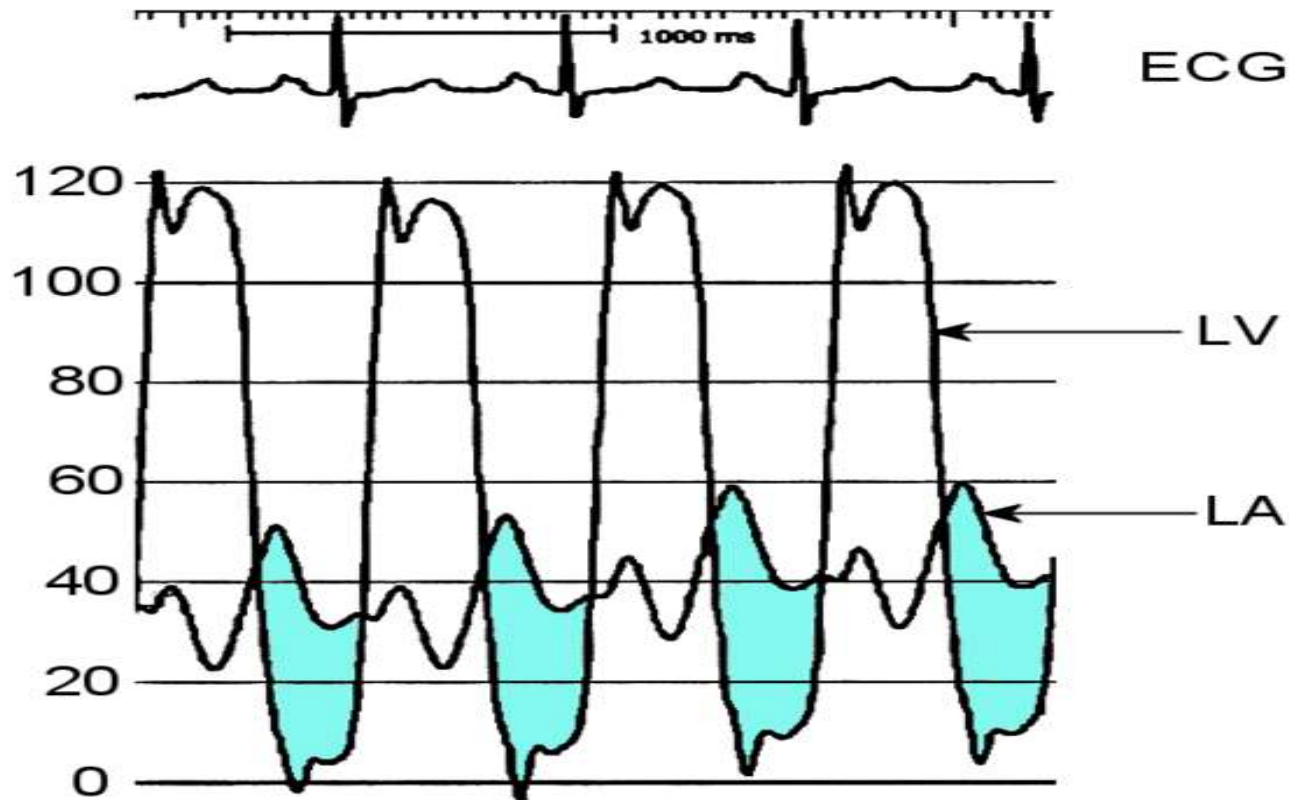


Transesophageal echocardiogram with continuous wave

Mitral valve stenosis: computed tomography



Mitral valve stenosis: cardiac catheterization



Shown is an image depicting intracardiac pressure measurements in an individual with severe mitral stenosis. Pressure tracings in the left atrium (LA) and the left ventricle (LV) in an individual with severe mitral stenosis. Blue areas represent the diastolic pressure gradient due to the stenotic valve.

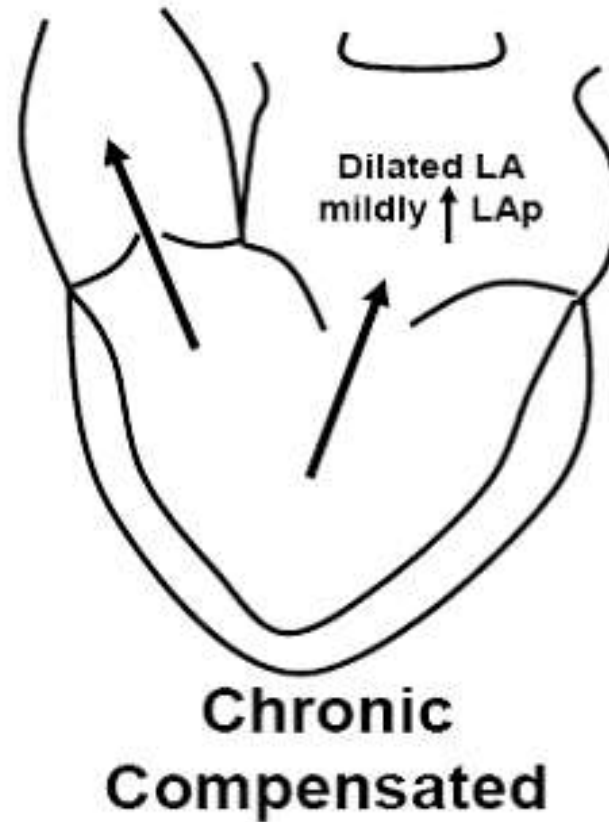
Mitral valve
insufficiency/regurgitation

Mitral valve insufficiency/regurgitation: definition, types, causes

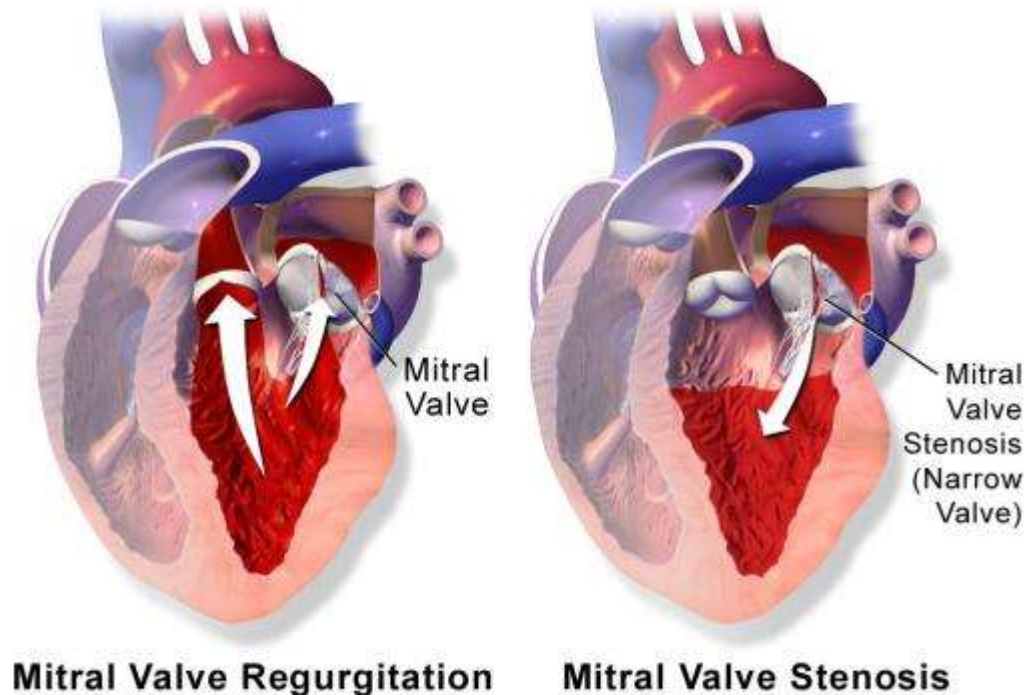
- Mitral insufficiency/regurgitation (MI) or mitral incompetence is a disorder of the heart in which the mitral valve does not close properly when the heart pumps out blood; it is the abnormal leaking of blood backwards from the left ventricle, through the mitral valve, into the left atrium, when the left ventricle contracts, i.e. there is regurgitation of blood back into the left atrium
- MI is the most common form of valvular heart disease
- Types: acute, chronic
- The most common cause of MI is mitral valve prolapse (MVP)
- Ischemic heart disease causes MI by the combination of ischemic dysfunction of the papillary muscles, and the dilatation of the left ventricle
- Rheumatic fever, Marfan's syndrome and Ehlers Danlos Syndrome are other typical causes
- Secondary mitral insufficiency is due to the dilatation of the left ventricle that causes stretching of the mitral valve annulus and displacement of the papillary muscles (dilated cardiomyopathy, etc.)

Mitral valve insufficiency/regurgitation: pathophysiology

- **Eccentric hypertrophy**
 - Increased preload
 - Increased afterload
 - Increased total stroke volume AND forward stroke volume AND LVESV returns to normal
- **Increased LA size**
 - Increased LA compliance
 - Larger volume at lower pressure

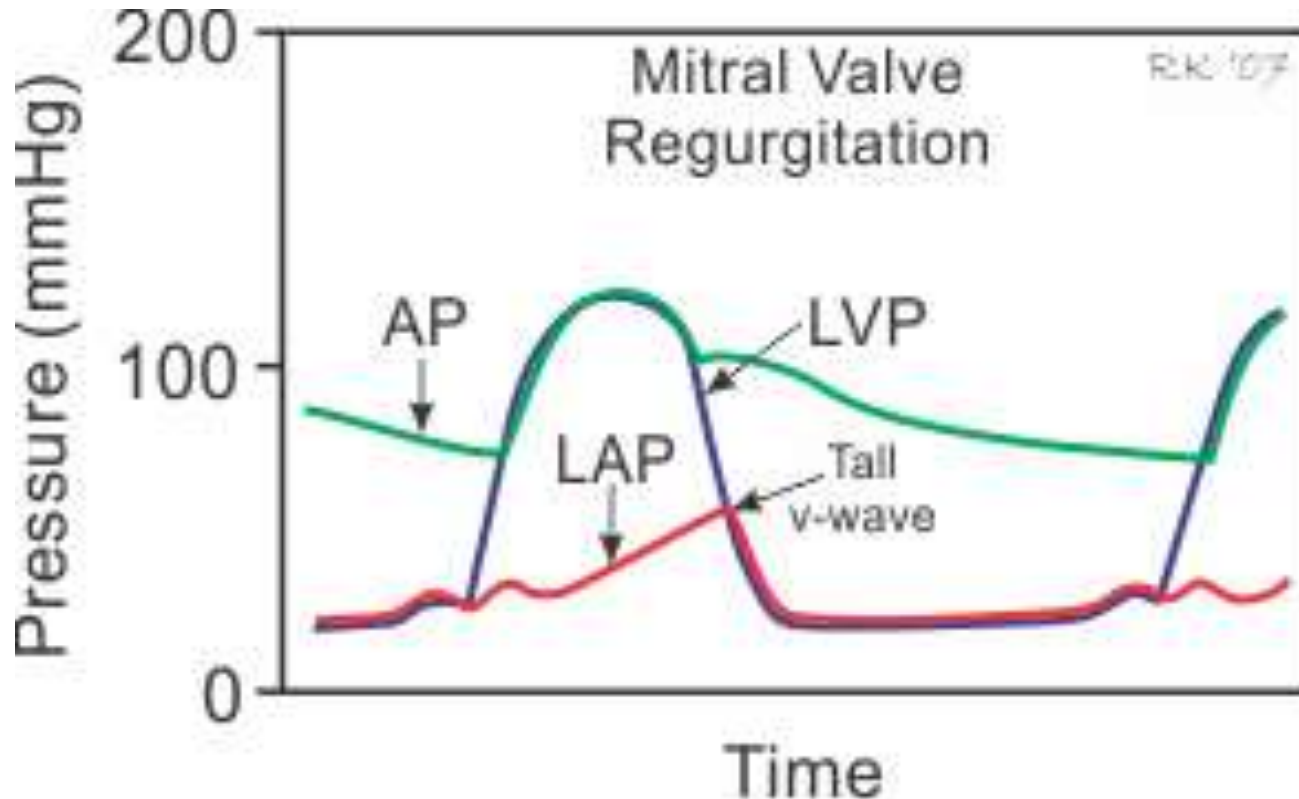


Mitral valve insufficiency/regurgitation: heart changes



Mitral valve insufficiency/regurgitation' and stenosis hearts:
find difference

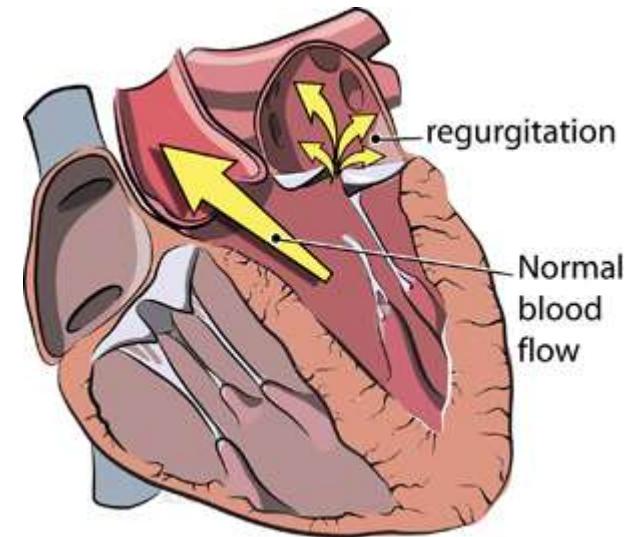
Mitral valve insufficiency/regurgitation: main hemodynamics disturbances



The changes in aortic pressure (AP), left ventricular pressure (LVP) and left atrial pressure (LAP)

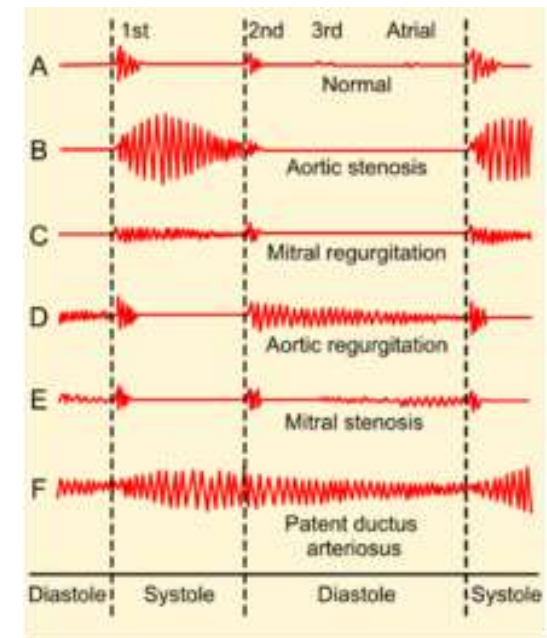
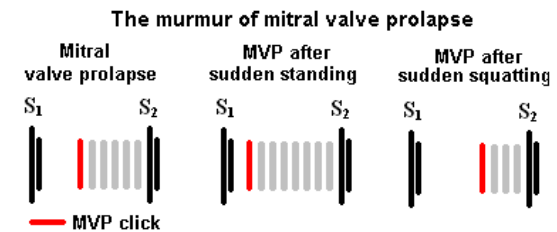
Mitral valve insufficiency/regurgitation: symptoms

- Symptoms appear as the left ventricle expands to accommodate the larger amount of blood (volume overload) flowing into the chamber
- The larger the left ventricle, the more advanced is the MR
- Symptoms include:
 - Shortness of breath with exertion, which may later develop into shortness of breath at rest and at night.
 - Fatigue and weakness
 - Edema (fluid buildup in the legs and feet, orthopnea, paroxysmal nocturnal dyspnea)
 - Heart palpitations (atrial fibrillation, which can lead to blood clots forming in the atrium)



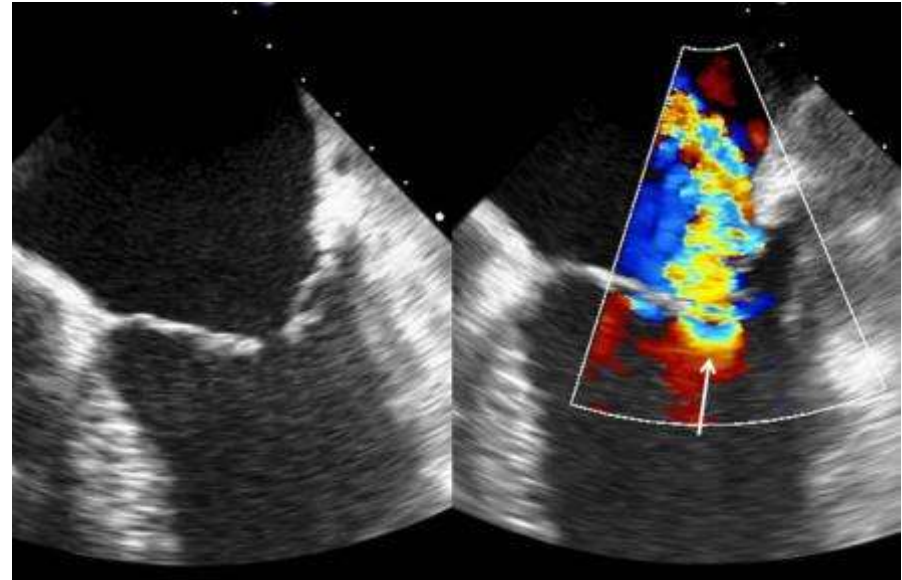
Mitral valve insufficiency/regurgitation: physical examination

- Asthenic body habitus
- Low body weight or body mass index (BMI)
- Straight-back syndrome
- Scoliosis or kyphosis
- Pectus excavatum
- Hypermobility of the joints (e.g., Marfan syndrome)
- The 1st heart sound (S_1) may be soft (or occasionally loud); a 3rd heart sound (S_3) at the apex reflects a dilated LV and important MR; an S_3 that accompanies mitral regurgitation suggests a dilated left ventricle and progression to heart failure
- The cardinal sign of MR is a holosystolic (pansystolic) murmur, heard best at the apex with the diaphragm of the stethoscope when the patient is in the left lateral decubitus position



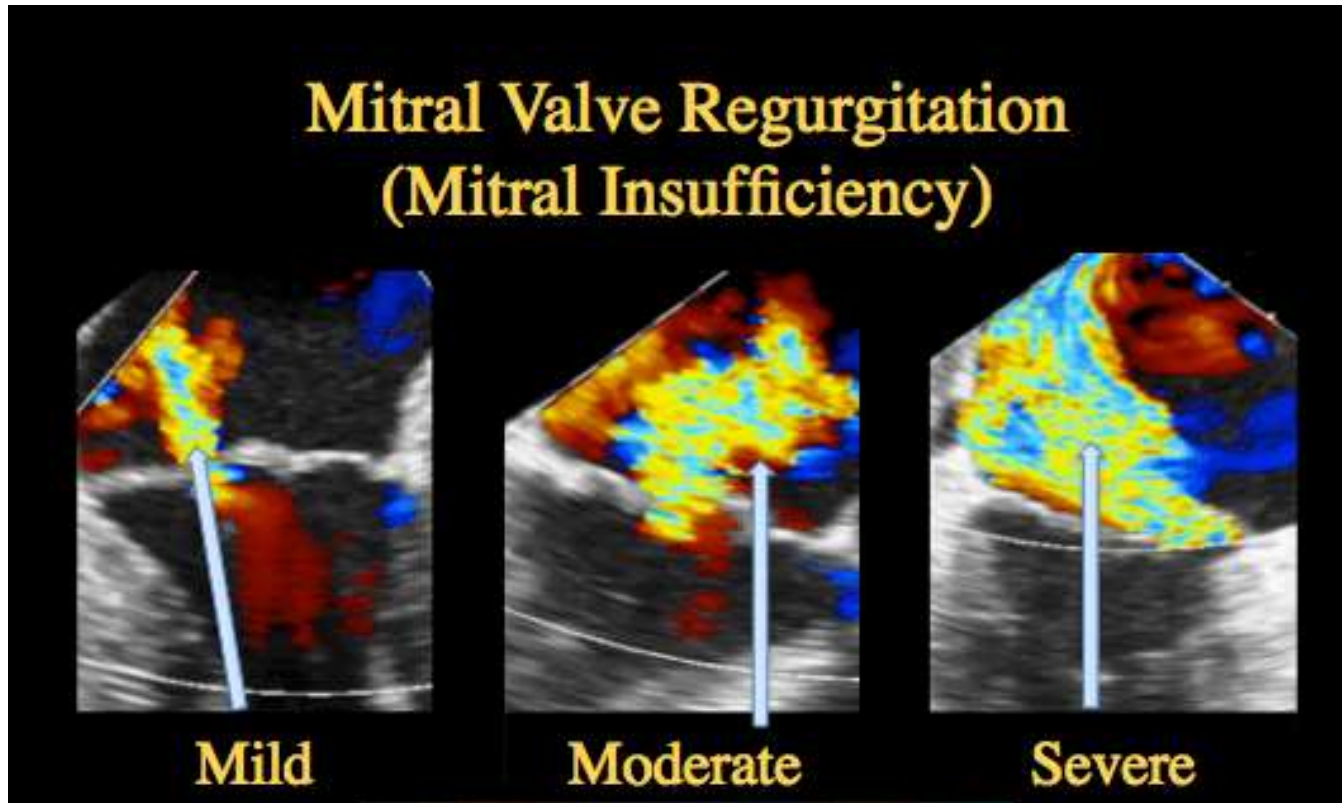
Mitral valve insufficiency/regurgitation: diagnostic tests

- Echocardiography
- Quantification of mitral insufficiency
- Cardiac magnetic resonance imaging
- Electrocardiography (ECG)
- Chest X-ray
- Cardiac catheterization



Transthoracic echocardiogram of secondary (functional) mitral regurgitation. With secondary mitral regurgitation, left ventricular dilation results in functional mitral regurgitation. The image shows failure of central coaptation of tethered mitral valve leaflets due to left ventricular dilation (left panel) with a color Doppler display (highlighted) of the resultant central jet of secondary mitral regurgitation (right panel).

Mitral valve insufficiency/regurgitation: echocardiography



Mitral valve insufficiency/regurgitation: quantification of mitral insufficiency

Degree of mitral regurgitation	Regurgitant fraction	Regurgitant Orifice area
Mild	< 20 percent	
Moderate	20 - 40 percent	
Moderate to severe	40 - 60 percent	
Severe	> 60 percent	> 0.4 cm ²

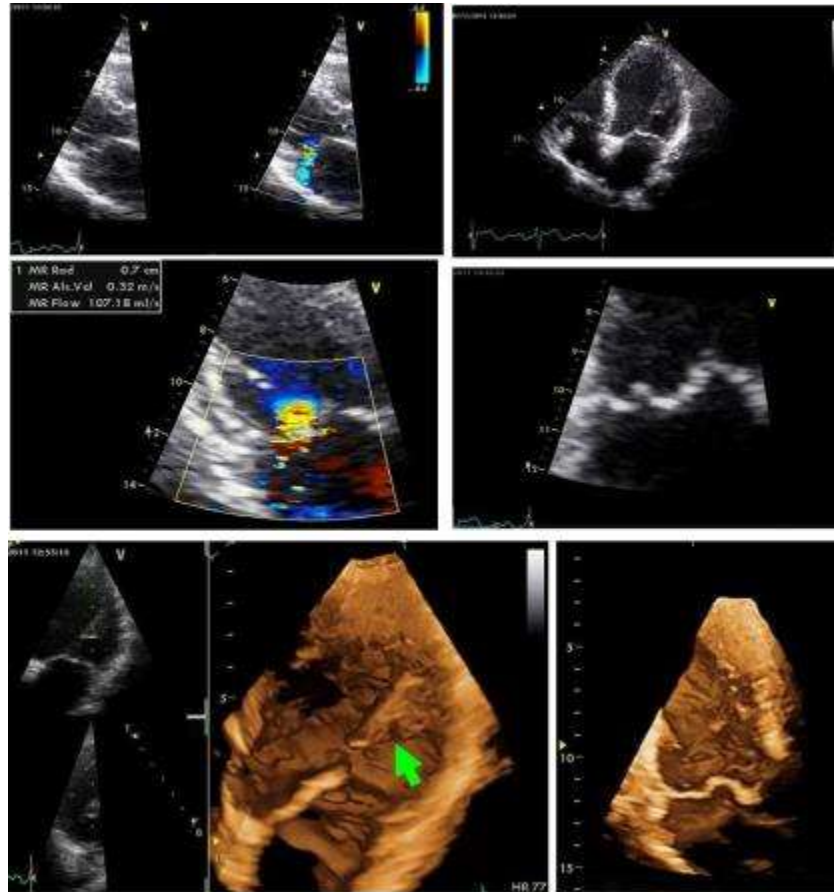
The degree of severity of MI can be quantified by the regurgitant fraction, which is the percentage of the left ventricular stroke volume that regurgitates into the left atrium

Mitral valve insufficiency/regurgitation: echocardiography



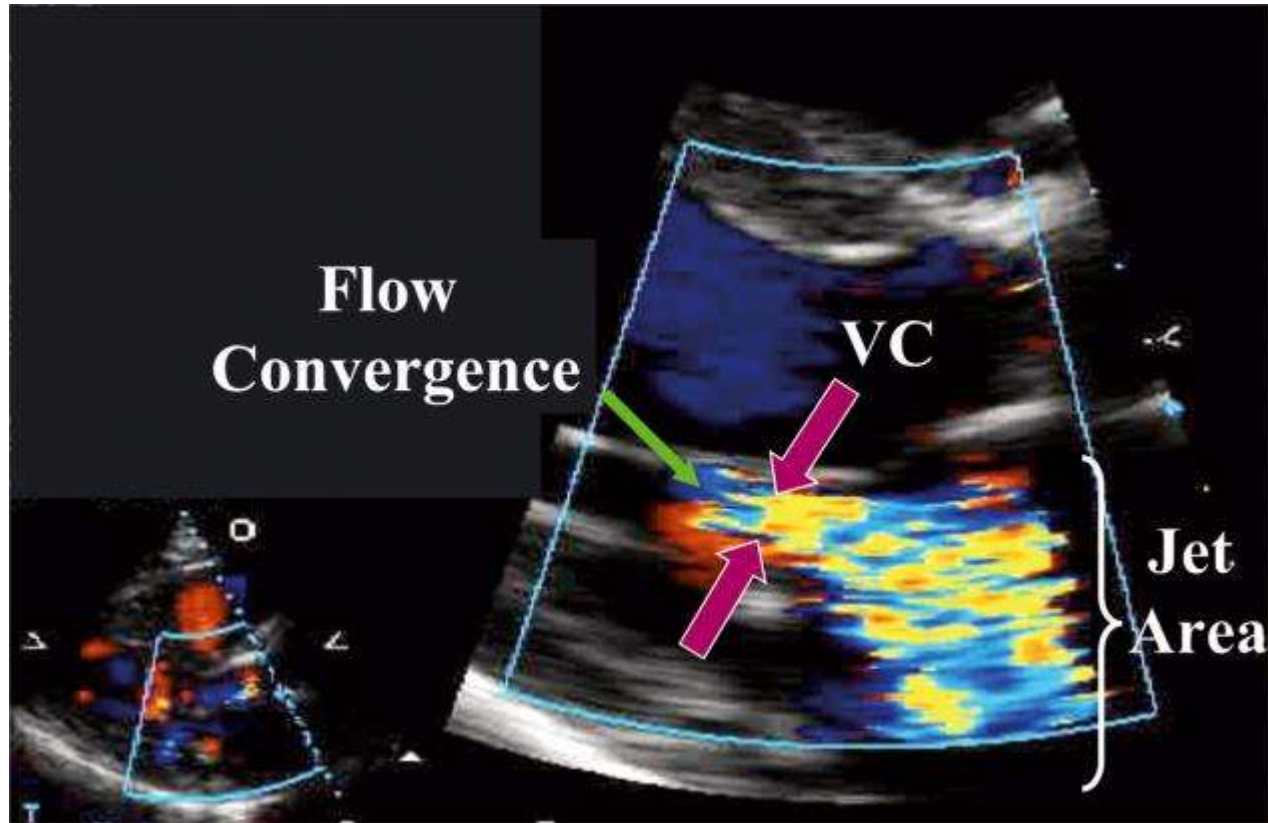
Transesophageal echocardiogram: apical 4-chamber projection where small vegetations can be observed on both mitral valves (arrows). Severe Mitral Regurgitation.

Mitral valve insufficiency/regurgitation: echocardiography



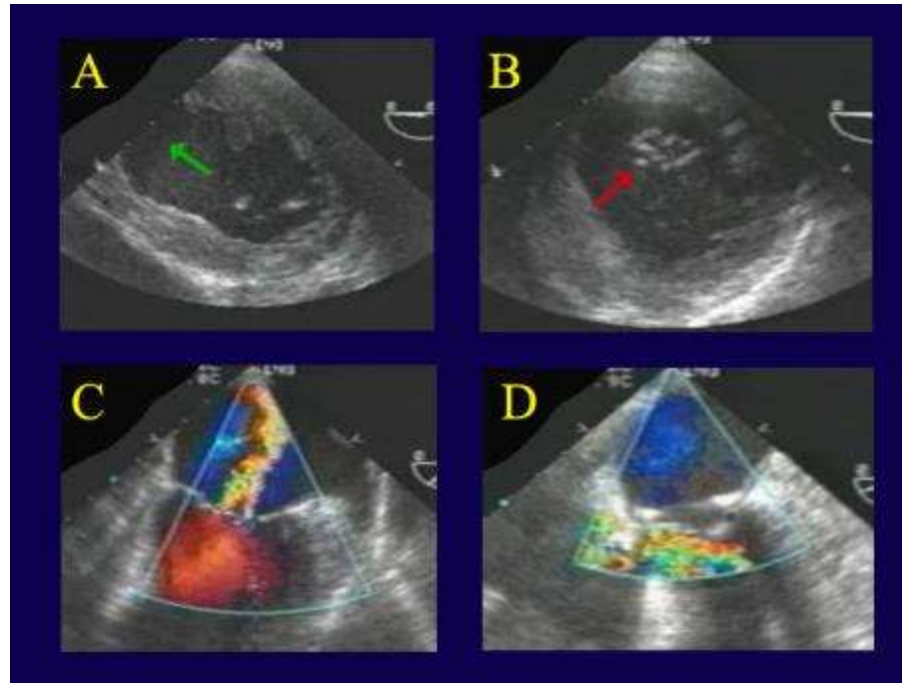
Ischemic mitral regurgitation due to acute elongation of papillary muscle, appearing as mitral valve prolapse

Mitral valve insufficiency/regurgitation: echocardiography



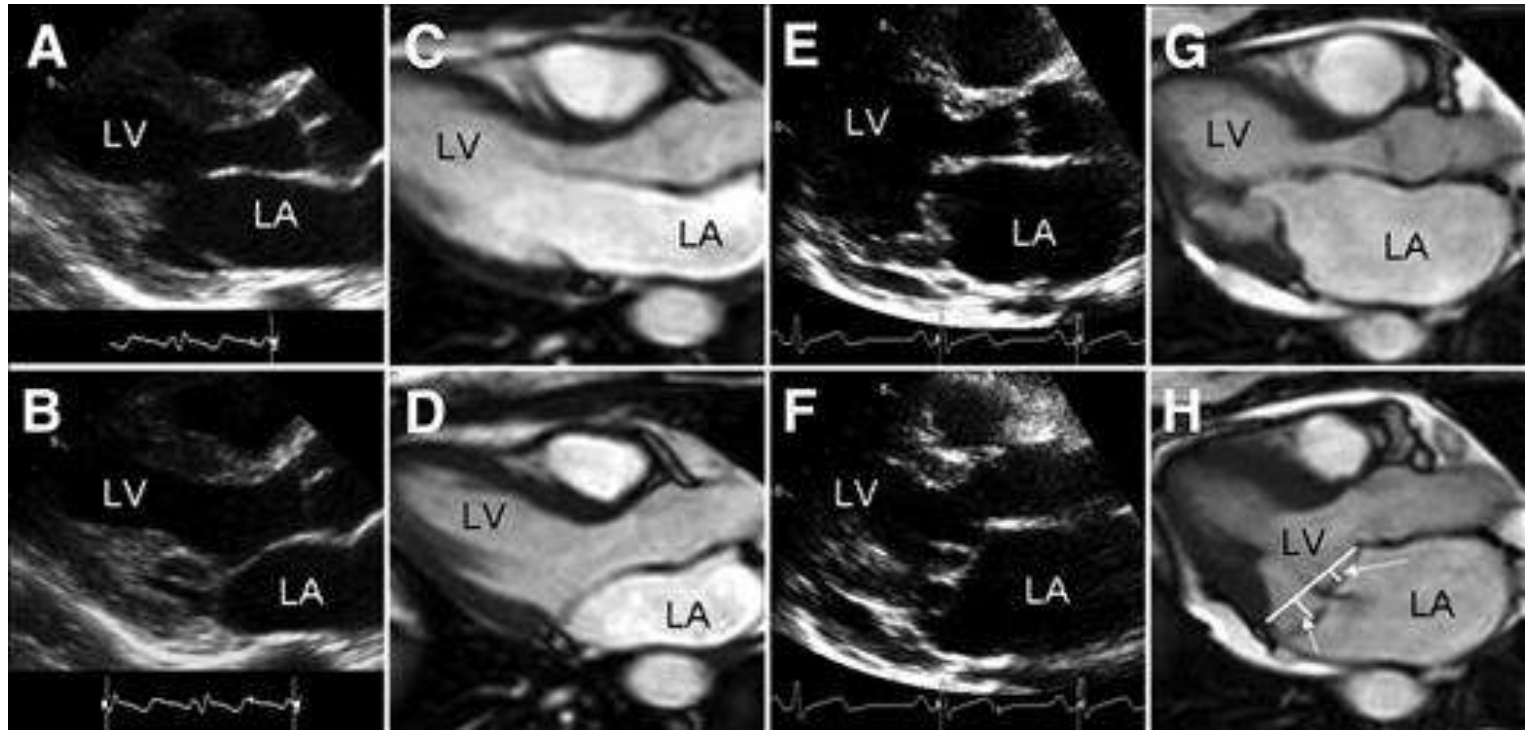
Color flow recording of a mitral regurgitation jet obtained from a zoomed view in the parasternal long axis depicting the three components of the regurgitant jet: flow convergence, vena contracta (VC), and jet area in the left atrium. Measurement of the vena contracta is shown between the red arrows. Vena contracta is defined as the narrowest central flow region of a jet that occurs at, or just downstream to, the orifice of a regurgitant valve.

Mitral valve insufficiency/regurgitation: echocardiography



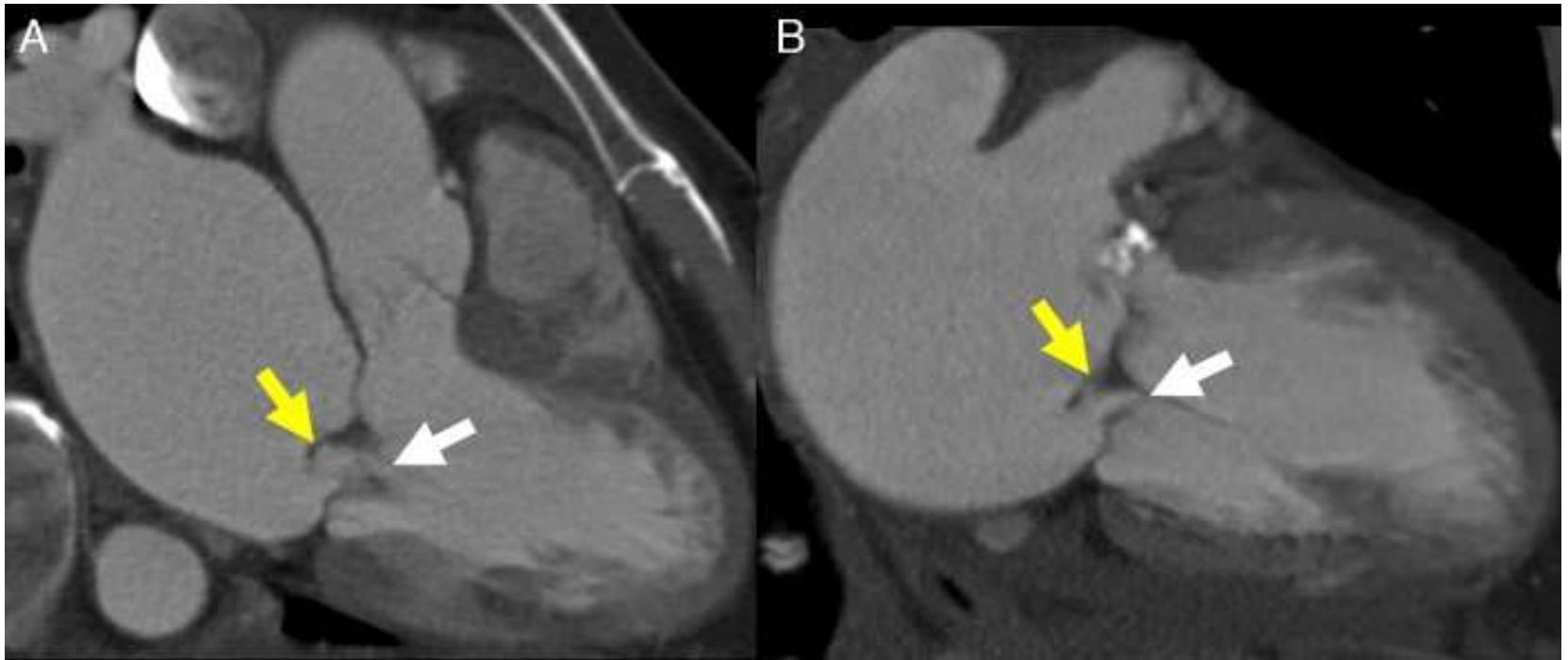
Transesophageal echocardiogram in a patient undergoing valve repair for ischemic mitral regurgitation. Panel A is a short axis view of the left ventricle, showing an expanded posterior-lateral wall infarct (green arrow). Panel B shows a gap in mitral coaptation at the posterior commissure during systole (red arrow), producing a central regurgitant jet (Panel C), but the leaflets are at the annular plane. This is the most common echocardiographic appearance of ischemic mitral regurgitation. In panel D, the valve is entirely competent after full ring annuloplasty alone.

Mitral valve insufficiency/regurgitation: echocardiography combine with cardiac magnetic resonance imaging



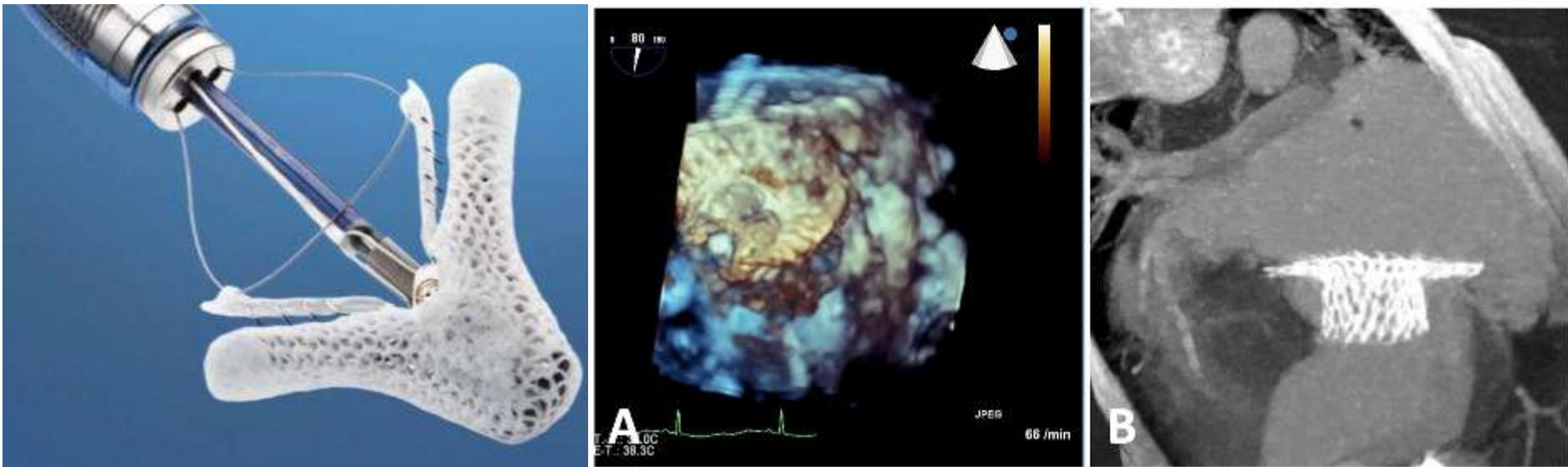
Control (A to D) and mitral valve prolapse (MVP) (E to H) patients. The two-dimensional transthoracic echocardiography (TTE) parasternal long-axis views (A, B, E, F) and cardiovascular magnetic resonance (CMR) left ventricle (LV) outflow tract views (C, D, G, H). (A, C, E, G) Diastole; (B, D, F, H) systole. In panel H, arrows indicate the prolapsed distance measured by the maximum distance of the prolapsed leaflet to the mitral annular plane. LA = left atrium.

Mitral valve insufficiency/regurgitation: cardiac magnetic resonance imaging



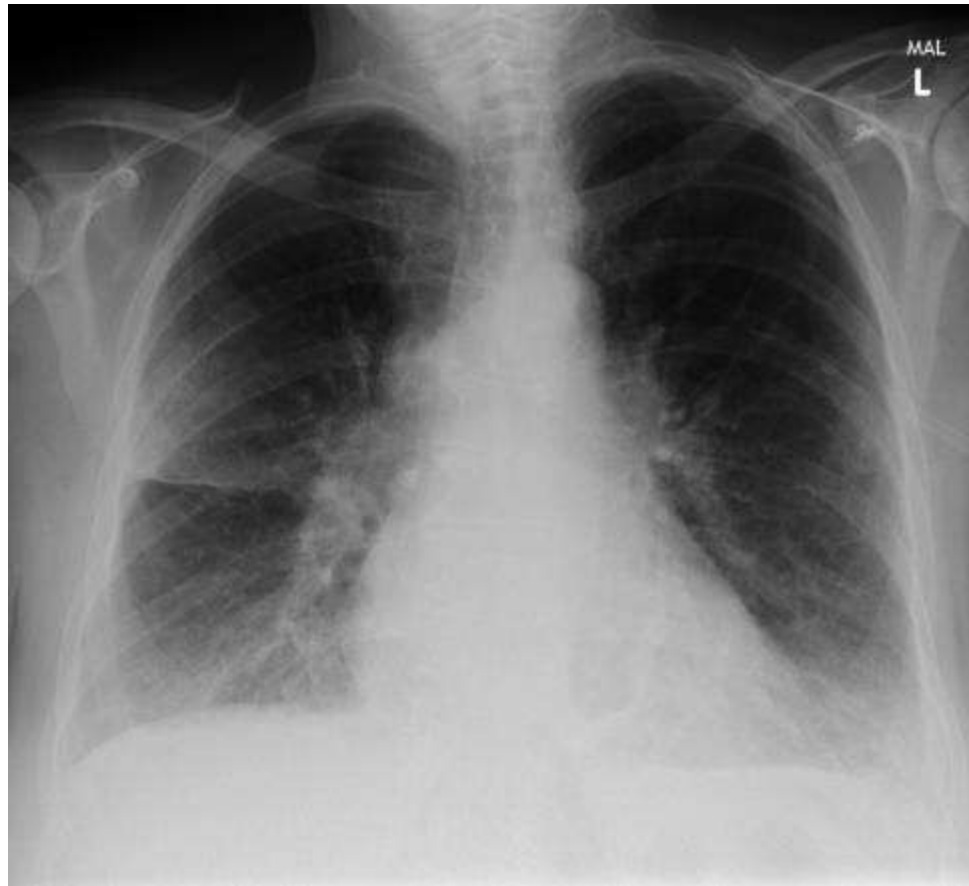
Mitral insufficiency in three-chamber (A) and two-chamber (B) views in diastole show a closure defect of the mitral valve (white arrow),

Mitral valve insufficiency/regurgitation: computer tomography



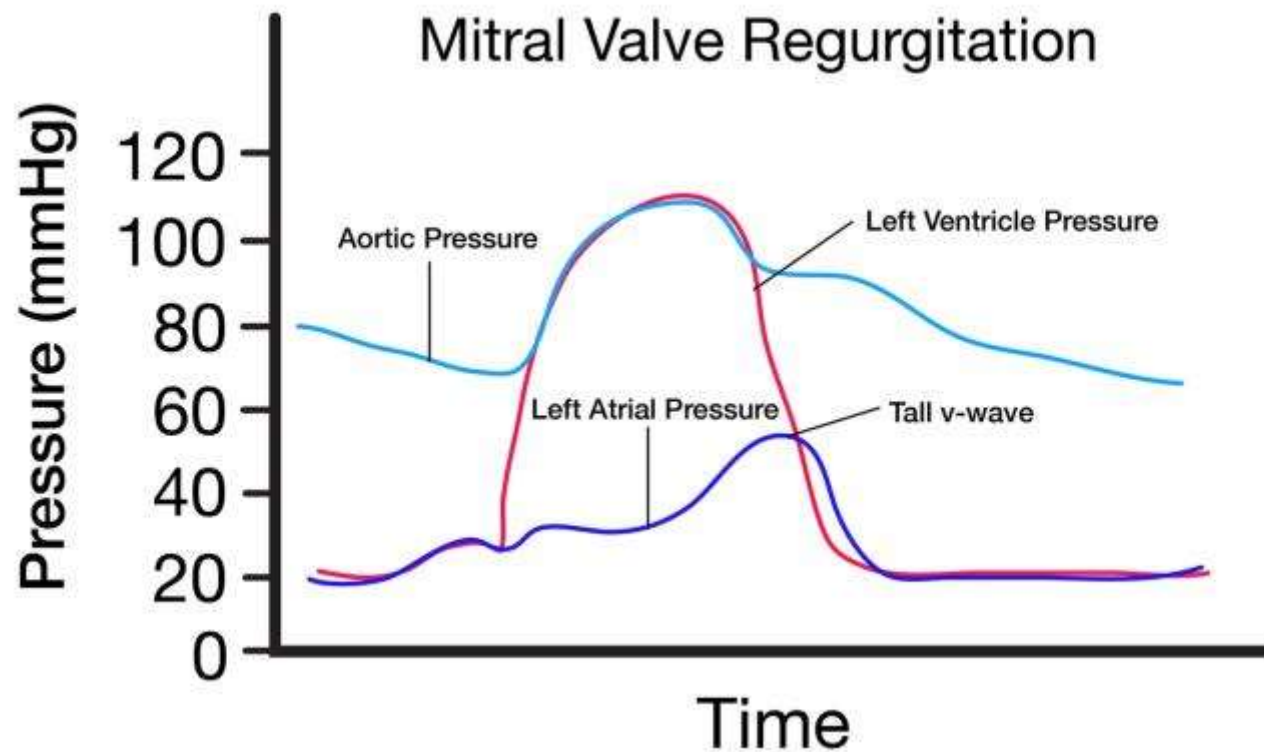
3D transesophageal echocardiographic image showing the valved stent after successful deployment in the native mitral annulus during systole.

Mitral valve insufficiency/regurgitation: chest X-ray



Unilateral pulmonary oedema in severe mitral regurgitation from posterior leaflet prolapse.

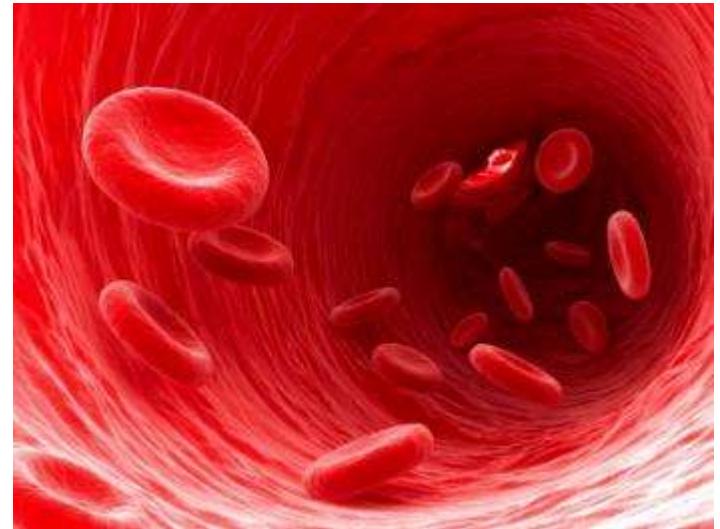
Mitral valve insufficiency/regurgitation: cardiac catheterisation



(Arterial) hypertension

(Arterial) hypertension: definition

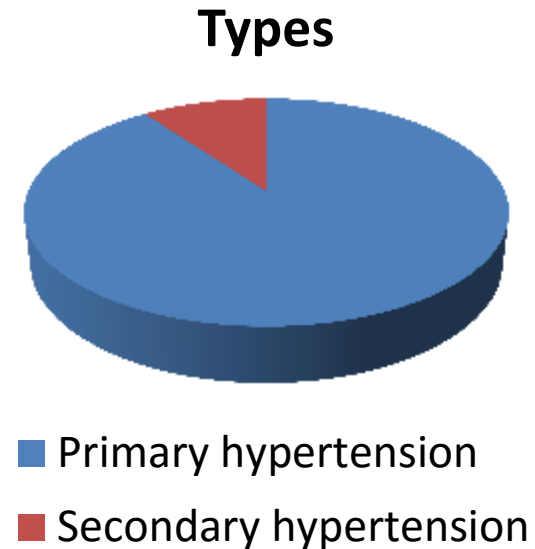
- Hypertension (HTN or HT), also known as high blood pressure or arterial hypertension, is a chronic medical condition in which the blood pressure in the arteries is elevated
- Hypertension is having a blood pressure higher than 139 over 89 (≥ 140 and/or ≥ 90) mmHg for most adults; different criteria apply to children



**The blood flowing inside vessels
exerts a force against the walls –
this is blood pressure**

(Arterial) hypertension: types

- Primary (essential) hypertension, defined as high blood pressure with no obvious underlying cause
- Secondary hypertension, defined as high blood pressure due to an identifiable cause, such as chronic kidney disease, narrowing of the aorta or kidney arteries; endocrine disorders such as excess aldosterone, cortisol, catecholamines overproduction, etc.

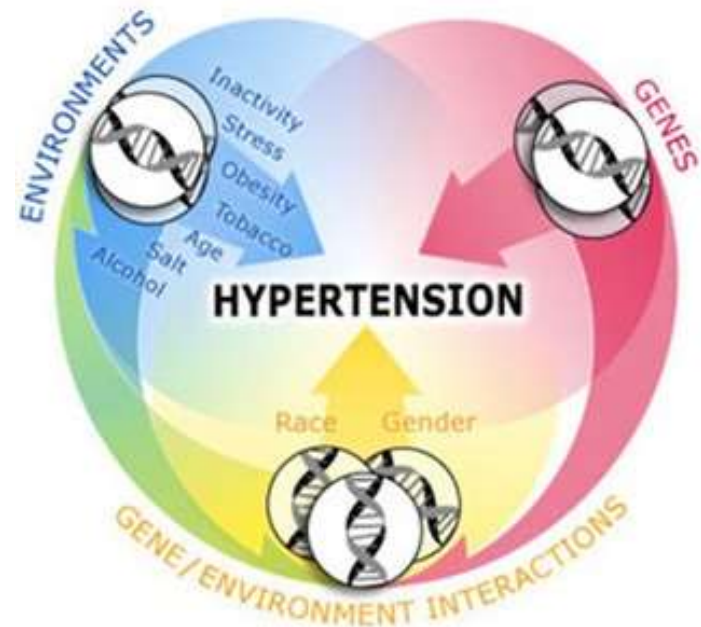


(Arterial) hypertension: classification of blood pressure for adults

Category	Systolic, mm Hg	Diastolic, mm Hg
Normal	90–119	60–79
High normal (Prehypertension)	120–139	80–89
Stage 1 hypertension	140–159	90–99
Stage 2 hypertension	160–179	100–109
Stage 3 hypertension (Hypertensive emergency)	≥180	≥110
Isolated systolic hypertension	≥140	<90

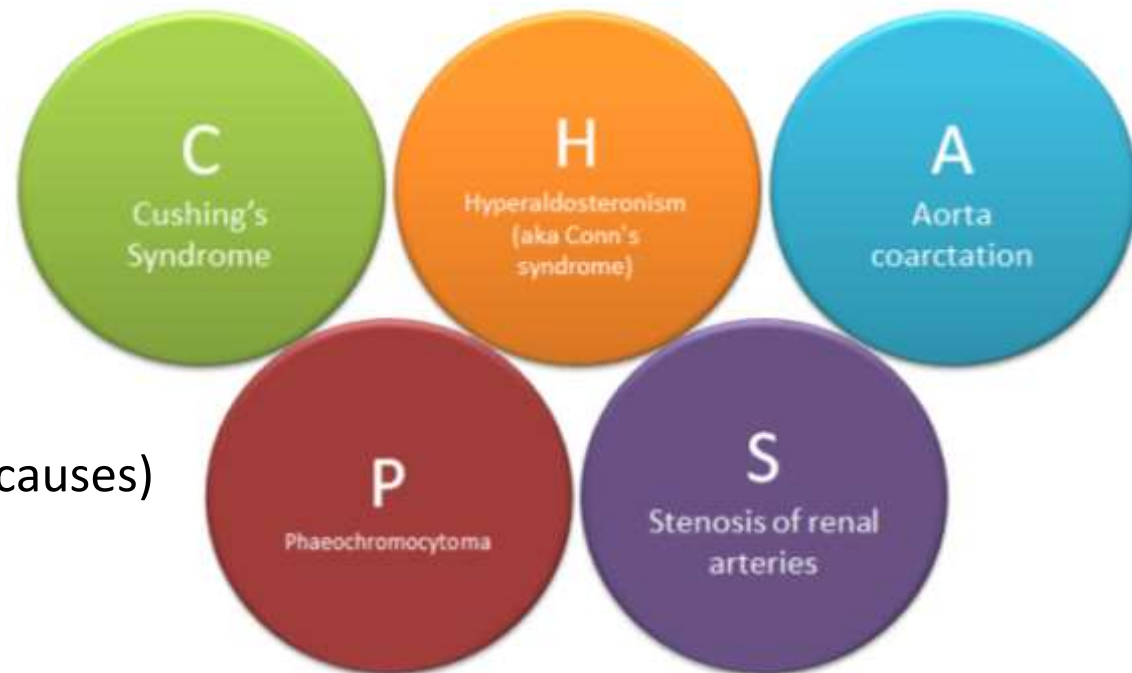
(Arterial) hypertension: causes of primary hypertension

- Hypertension results from a complex interaction of genes and environmental factors
- Numerous common genetic variants with small effects on blood pressure have been identified as well as some rare genetic variants with large effects on blood pressure, but the genetic basis of hypertension is still poorly understood



(Arterial) hypertension: causes of secondary hypertension

- Kidney disease
- Cushing's syndrome
- Hyperthyroidism
- Hypothyroidism
- Acromegaly
- Conn's syndrome
- Hyperaldosteronism (other causes)
- Hyperparathyroidism
- Pheochromocytoma
- Obesity
- Sleep apnea
- Pregnancy
- Drug-induced
- Etc.



Mnemonic "CHAPS"

(Arterial) hypertension: hypertensinogenic (risk) factors

- Age
- Race
- Sex
- Family history
- Obesity
- A sedentary lifestyle
- Insulin resistance
- Using tobacco
- High alcohol intake
- High salt intake
- Stress
- Dyslipidemia
- Low potassium intake
- Low calcium intake
- Too little vitamin D in diet
- Certain chronic conditions

(Arterial) hypertension: SCORE and HeartScore

- SCORE (Systematic Coronary Risk Evaluation) is a cardiovascular disease risk assessment system initiated by the European Society of Cardiology
- SCORE is based on the following risk factors: gender, age, smoking, systolic blood pressure and total cholesterol
- HeartScore is the interactive version of SCORE
- The threshold for high risk based on fatal cardiovascular events is defined as "higher than 5%", instead of the previous "higher than 20%" using a composite coronary endpoint



<http://www.heartscore.org>

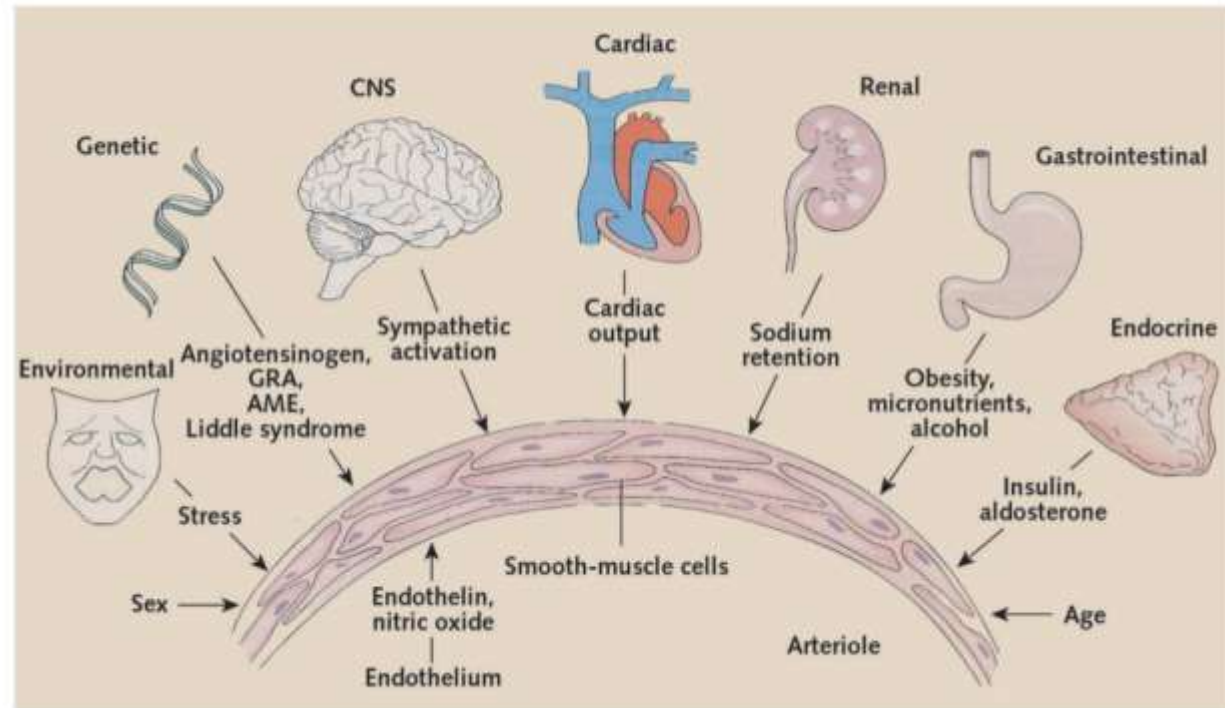
(Arterial) hypertension: stratification of total cardiovascular disease risk

Other risk factors, asymptomatic organ damage or disease	Blood Pressure (mmHg)			
	High normal SBP 130–139 or DBP 85–89	Grade 1 HT SBP 140–159 or DBP 90–99	Grade 2 HT SBP 160–179 or DBP 100–109	Grade 3 HT SBP ≥180 or DBP ≥110
No other RF		Low risk	Moderate risk	High risk
1–2 RF	Low risk	Moderate risk	Moderate to high risk	High risk
≥3 RF	Low to Moderate risk	Moderate to high risk	High Risk	High risk
OD, CKD stage 3 or diabetes	Moderate to high risk	High risk	High risk	High to very high risk
Symptomatic CVD, CKD stage ≥4 or diabetes with OD/RFs	Very high risk	Very high risk	Very high risk	Very high risk

BP = blood pressure; CKD = chronic kidney disease; CV = cardiovascular; CVD = cardiovascular disease; DBP = diastolic blood pressure; HT = hypertension; OD = organ damage; RF = risk factor; SBP = systolic blood pressure.

(Arterial) hypertension: pathophysiology

- Key factors:
 - Abnormal Na transport
 - Increased sympathetic nervous activity
 - Increased renin-angiotensin-aldosterone system activity
 - Vasodilator deficiency



AME - apparent mineralocorticoid excess; **CNS** - central nervous system; **GRA** - glucocorticoid-remediable aldosteronism

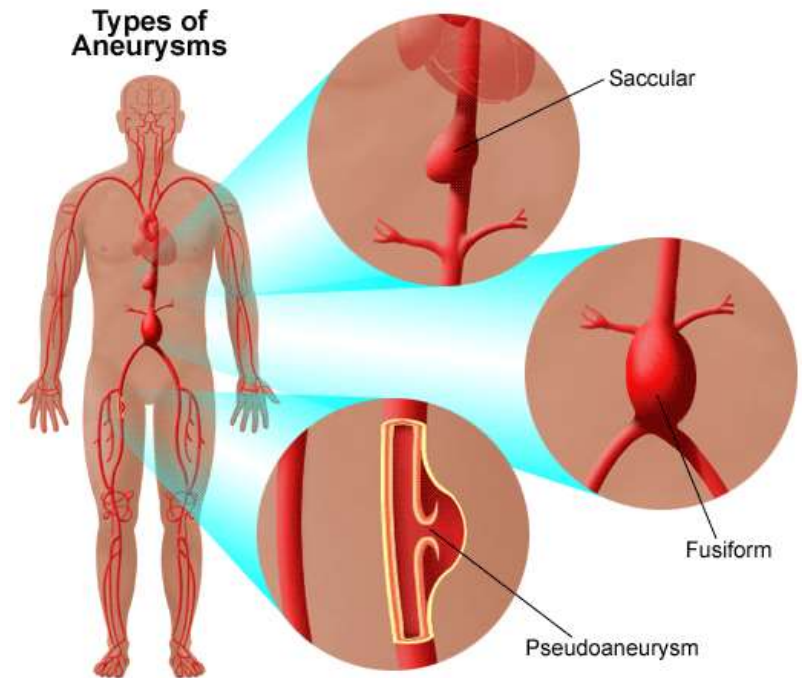
(Arterial) hypertension: signs and symptoms

- Most people with high blood pressure have no signs or symptoms, even if blood pressure readings reach dangerously high levels
- A few people with high blood pressure may have headaches, shortness of breath or nosebleeds, but these signs and symptoms aren't specific and usually don't occur until high blood pressure has reached a severe or life-threatening stage



(Arterial) hypertension: main complications

- Hypertensive heart disease
- Coronary artery disease
- Stroke
- Aortic aneurysm
- Peripheral artery disease
- Chronic kidney disease
- Chronic heart failure
- Hypertensive retinopathy

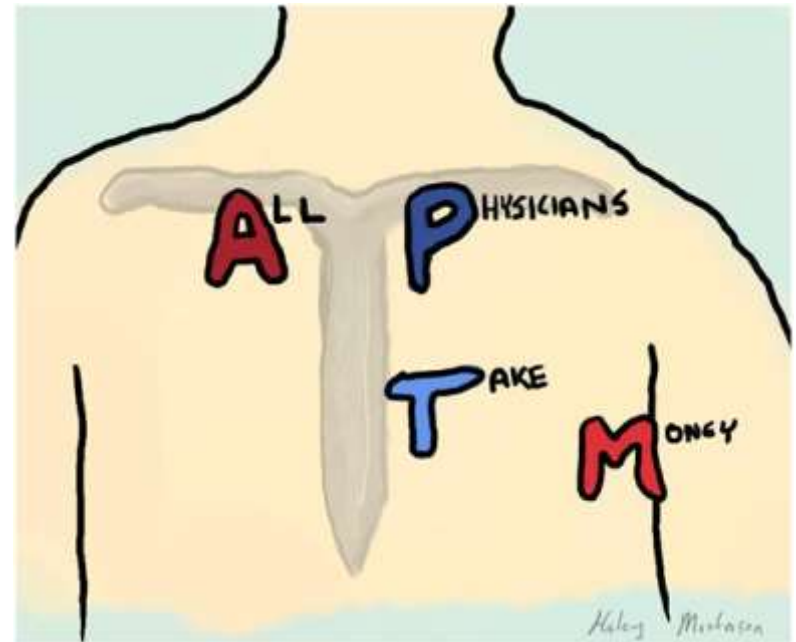


(Arterial) hypertension: medical history

- The known duration of hypertension and previously recorded levels
- Any history or symptoms of coronary artery disease (CAD), heart failure (HF)
- Other relevant coexisting disorders (e.g., stroke, renal dysfunction, peripheral arterial disease, dyslipidemia, diabetes, gout)
- Family history of any of these disorders
- Social history includes exercise levels and use of tobacco, alcohol, and stimulant drugs (prescribed and illicit)
- A dietary history focuses on intake of salt and stimulants (e.g., tea, coffee, caffeine-containing sodas, energy drinks)
- Lifestyle factors
- Current and previous medications

(Arterial) hypertension: physical examination

- Height, weight, and waist circumference
- Funduscopic examination for retinopathy
- Auscultation for bruits in the neck and abdomen (a unilateral renal artery bruit may be heard in slim patients with renovascular hypertension)
- Full cardiac, respiratory, and neurologic examination
- Heart auscultation (a 4th heart sound is one of the earliest signs of hypertensive heart disease)
- The abdomen palpation for kidney enlargement and abdominal masses
- Peripheral arterial pulses investigation (diminished or delayed femoral pulses suggest aortic coarctation, particularly in patients < 30)

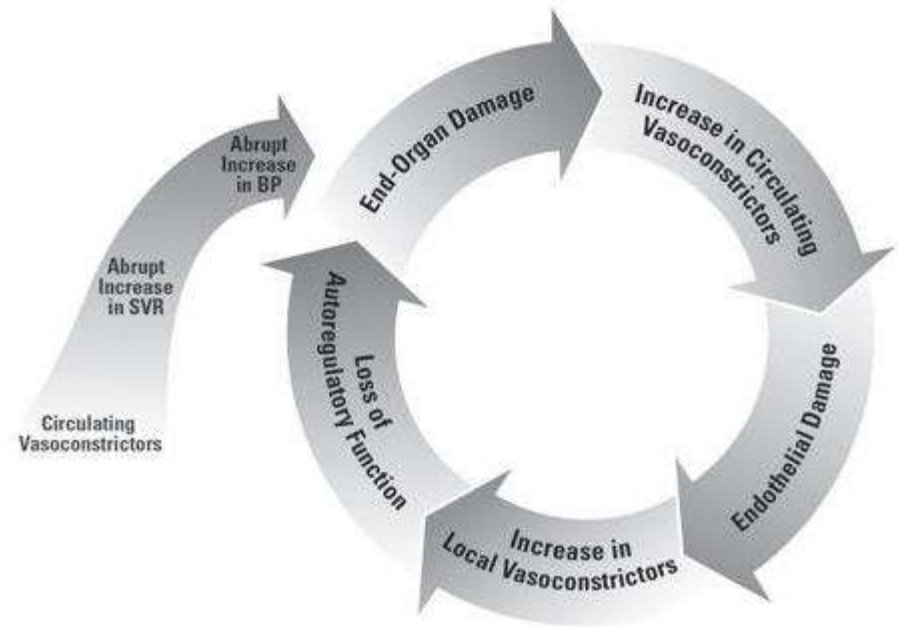


Aortic, Pulmonic, Tricuspid, Mitral

(Arterial) hypertension: hypertensive crisis

- Severely elevated blood pressure equal to or greater than a systolic 180 or diastolic of 110 is referred to as a hypertensive crisis
- Hypertensive crisis is categorized as hypertensive urgency, according to the presence or absence of end organ damage
- The most affected organs include the brain, kidney, heart, aorta and lungs

In hypertensive emergency, the blood pressure must be reduced rapidly to stop ongoing organ damage



Pathophysiologic mechanism, SVR - systemic vascular resistance, BP – blood pressure

(Arterial) hypertension: diagnosis

- Multiple measurements of blood pressure (BP) to confirm
- Urinalysis and urinary albumin: creatinine ratio
- Blood tests: fasting lipids, hematocrit, creatinine, serum potassium (K), creatinine (or the corresponding estimated glomerular filtration rate), calcium, lipid profile, glucose
- Renal ultrasonography if creatinine increased
- Evaluate for aldosteronism if K decreased
- ECG: If left ventricular hypertrophy, consider echocardiography
- Sometimes measurement of thyroid-stimulating hormone, T3-T4 hormones, cortisol
- Evaluation for pheochromocytoma or a sleep disorder if BP elevation sudden and labile or severe



Blood pressure is measured by sphygmomanometry.

(Arterial) hypertension: office blood pressure monitoring

- The patient should be seated comfortably with the back supported and the upper arm bared without constrictive clothing
- The legs should not be crossed
- The arm should be supported at the level of the heart, and the bladder of the blood pressure (BP) cuff should encircle at least 80% of the arm circumference
- The BP measuring device should be deflated at the rate of 2 to 3 mm/sec, and the first and last audible sounds should be taken as the systolic and diastolic pressure respectively
- Neither the patient nor the observer should talk during the measurement
- Measurements may be both while seated and after standing, to look for orthostatic or postural hypotension
- At least the first measurement should be done on the right and left arms

(Arterial) hypertension: office blood pressure monitoring

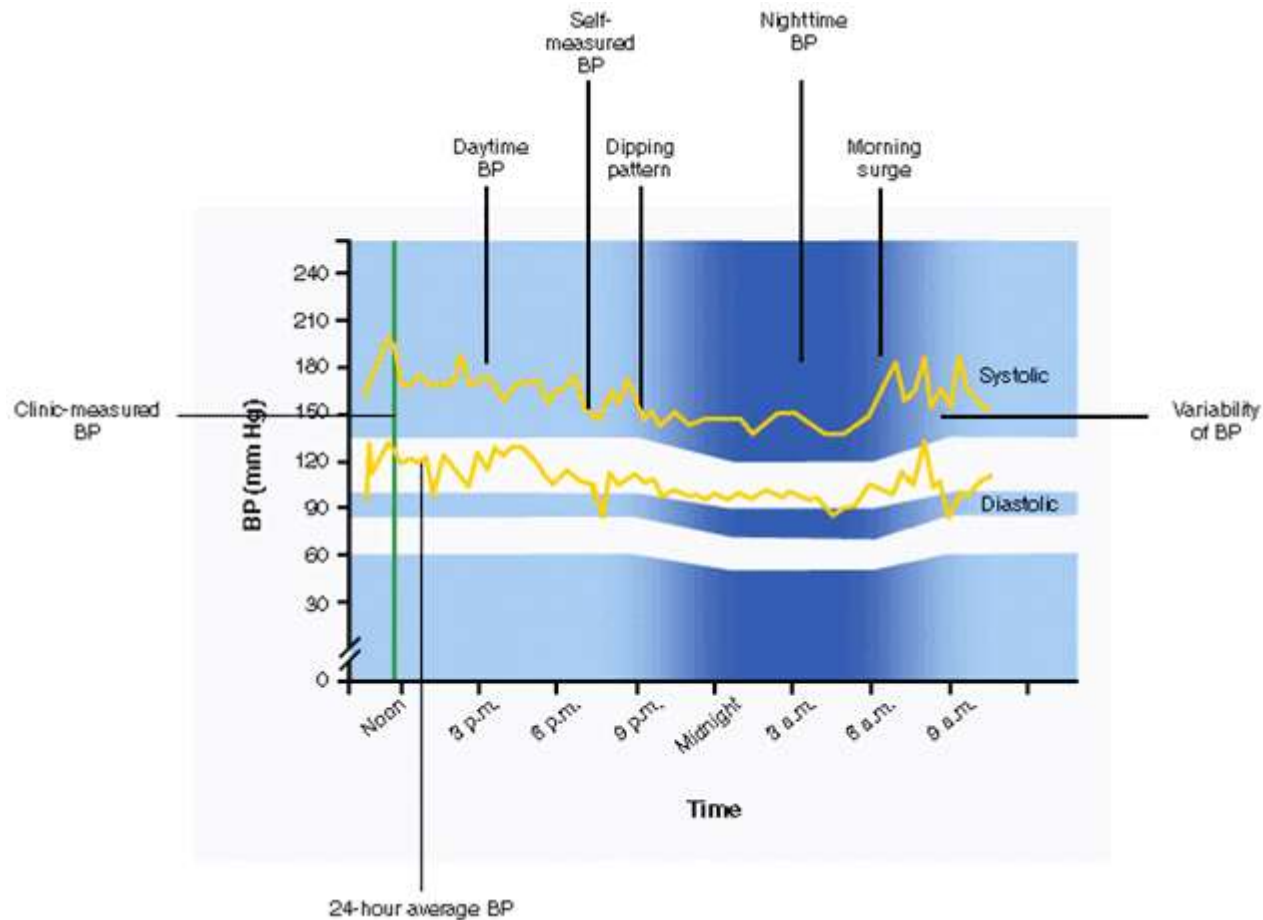


Man getting his blood pressure taken at the doctor's office.

(Arterial) hypertension: ambulatory blood pressure monitoring

- The National Institute of Health and Clinical Excellence (NICE) guidelines recommend that a diagnosis of primary hypertension should be confirmed with 24-hour ambulatory blood pressure monitoring or home blood pressure monitoring rather than by relying solely on office blood pressure measurement
- Twenty-four-hour ambulatory BP monitoring is indicated to rule out white-coat hypertension, to uncover apparent drug resistance (office resistance), to better define resistant hypertension, to identify hypotensive symptoms while the patient is being treated with anti-hypertensive medications, to monitor episodic hypertension, and to identify autonomic dysfunction states
- Twenty-four-hour ambulatory BP monitoring also helps identify abnormal patterns in blood pressure that could remain undetected if a patient is evaluated based on physician office blood pressure measurements alone

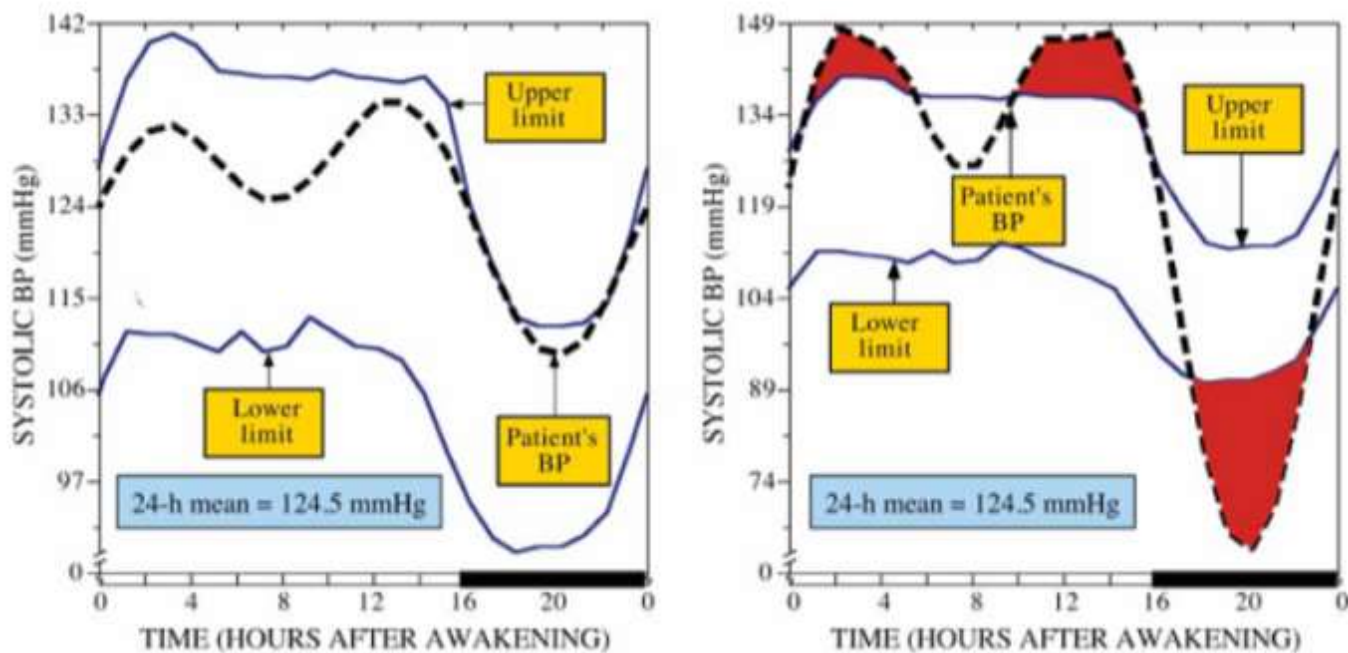
(Arterial) hypertension: ambulatory blood pressure monitoring



(Arterial) hypertension: extent of the night time BP attenuation

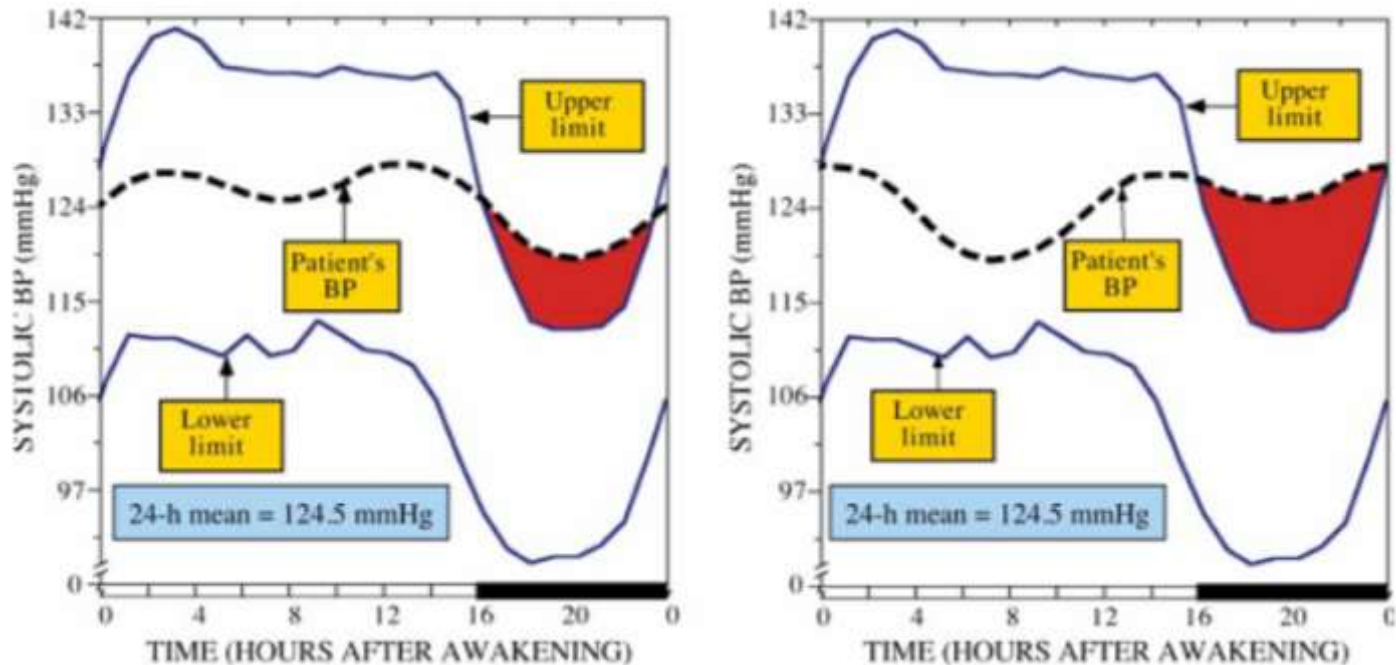
- The extent of the nighttime BP attenuation has been mainly quantified through the so-called “sleep-time relative BP decline”, which is defined as the percent decrease in mean BP during nighttime sleep relative to the mean BP during daytime activity
- More recently, the classification has been extended by dividing individuals into four groups:
 - Extreme-dippers (sleep-time relative BP decline $>20\%$)
 - Dippers (sleep-time relative BP decline $\geq 10\%$ but $<20\%$)
 - Non dippers (sleep-time relative BP decline $<10\%$)
 - Inverse-dippers or risers (sleep-time relative BP decline $<0\%$, indicating asleep BP $>$ awake BP mean)

(Arterial) hypertension: ambulatory blood pressure monitoring



24-h SBP pattern (dashed thick lines) of a normotensive dipper subject (left) and a hypertensive extreme-dipper patient (right), plotted with respect to circadian time-specified tolerance limits(continuous thin lines), calculated from a reference population of normotensive individuals as a function of their rest-activity cycle and sex.

(Arterial) hypertension: ambulatory blood pressure monitoring



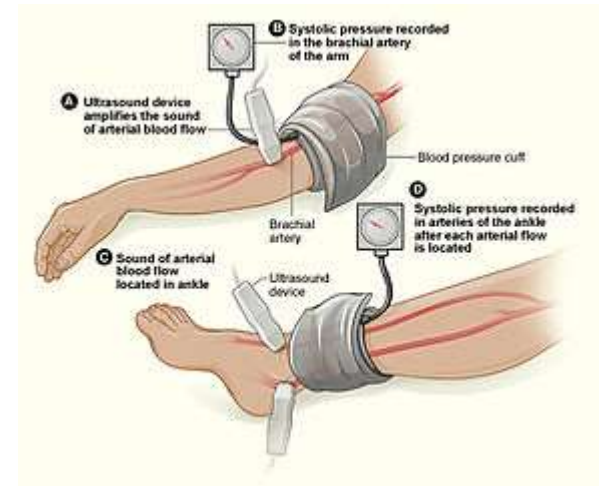
24-h SBP pattern (dashed thick lines) of a hypertensive non-dipper (left) and a hypertensive riser patient (right), plotted with respect to circadian time-specified tolerance limits (continuous thin lines), calculated from a reference population of normotensive individuals as a function of their rest-activity cycle and sex.

(Arterial) hypertension: home blood pressure monitoring

- The home BP is a better predictor of cardiovascular morbidity and mortality than are office BP measurements
- Hypertension is defined as a mean home blood pressure of $\geq 135/85$ mmHg
- Home blood pressure monitoring provides an inexpensive alternative to 24-hour ambulatory BP monitoring which is not yet widely available
- One of the main drawbacks in home blood pressure measurement when compared to 24-hour ambulatory BP monitoring, is that sleep time blood pressures cannot be recorded and therefore those patients with abnormal dipping pattern in blood pressure and nocturnal hypertension will be missed

(Arterial) hypertension: ankle brachial index

- The ankle brachial pressure index (ABPI or ankle brachial index (ABI) is the ratio of the blood pressure in the lower legs to the blood pressure in the arms
- Compared to the arm, lower blood pressure in the leg is an indication of blocked arteries (peripheral artery disease or PAD) or secondary arterial hypertension due to aortic coarctation
- The ABI is calculated by dividing the systolic blood pressure at the ankle by the systolic blood pressures in the arm



(Arterial) hypertension: ankle brachial index interpretation

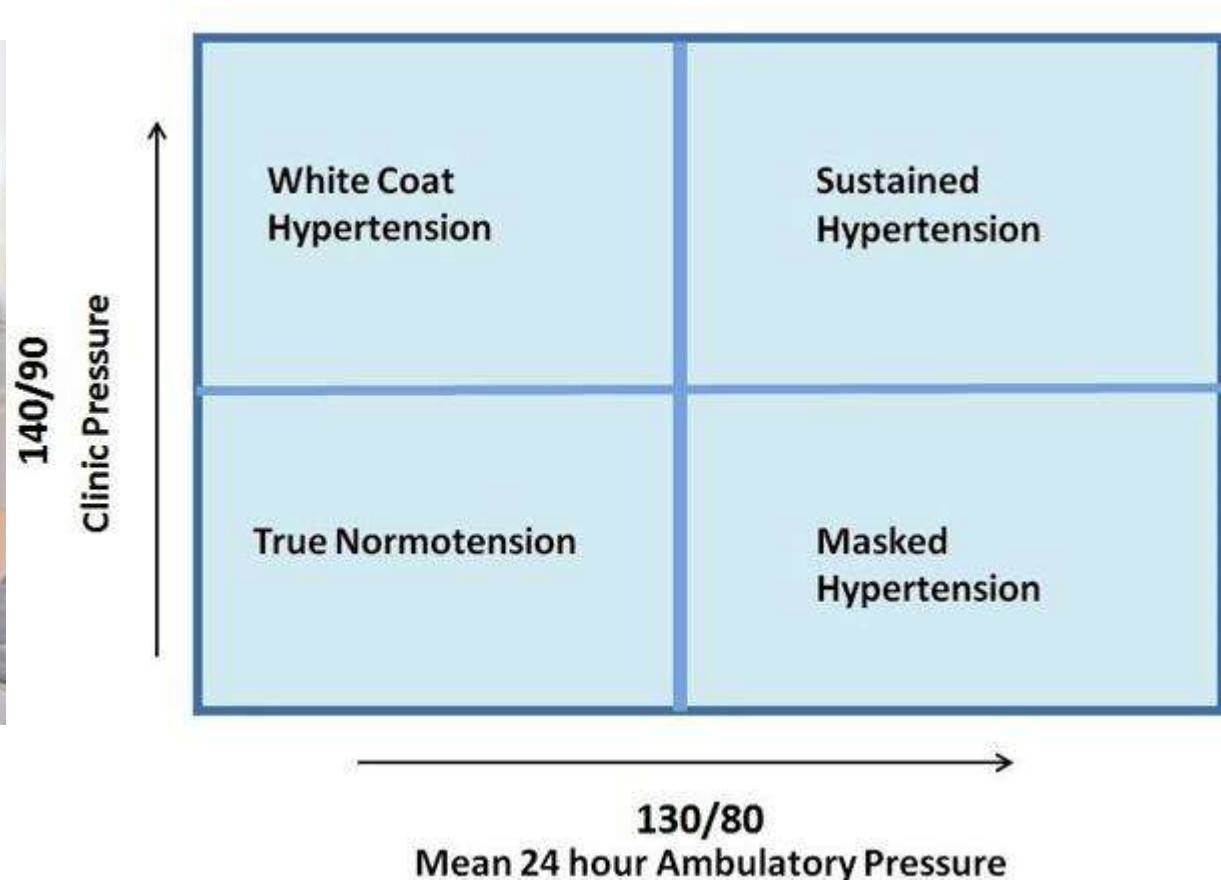
ABPI value	Interpretation	Action	Nature of ulcers , if present
above 1.2	Abnormal vessel hardening from PVD	Refer routinely	Venous ulcer use full compression bandaging
1.0 - 1.2	Normal range	None	
0.9 - 1.0	Acceptable		
0.8 - 0.9	Some arterial disease	Manage risk factors	
0.5 - 0.8	Moderate arterial disease	Routine specialist referral	Mixed ulcers use reduced compression bandaging
under 0.5	Severe arterial disease	Urgent specialist referral	Arterial ulcers no compression bandaging used

ABPI - the ankle brachial pressure index

(Arterial) hypertension: patterns of blood pressure



The time of change color and
model of coat

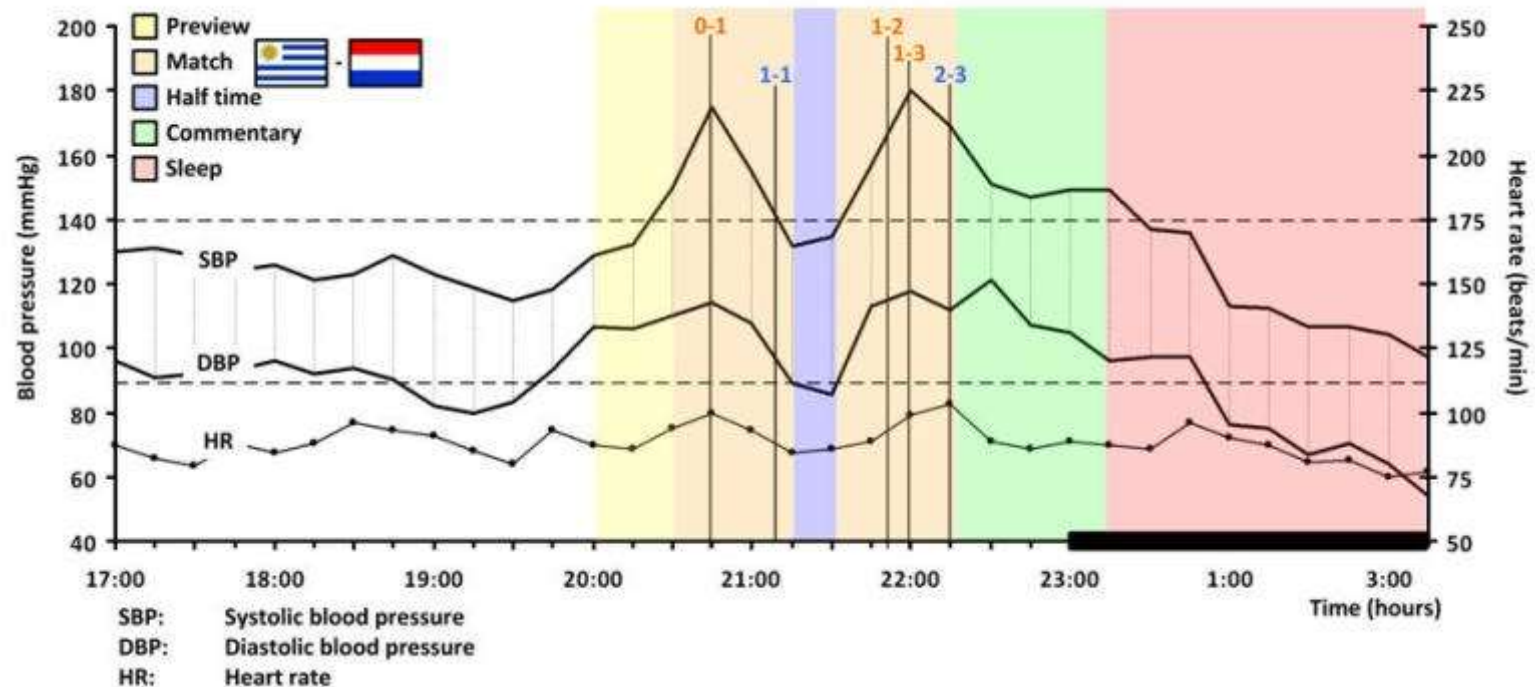


(Arterial) hypertension: white coat hypertension

- White coat hypertension, more commonly known as white coat syndrome, is a phenomenon in which patients exhibit a blood pressure level above the normal range, in a clinical setting, though they don't exhibit it in other settings
- It is believed that the phenomenon is due to anxiety that those afflicted experience, during a clinic visit



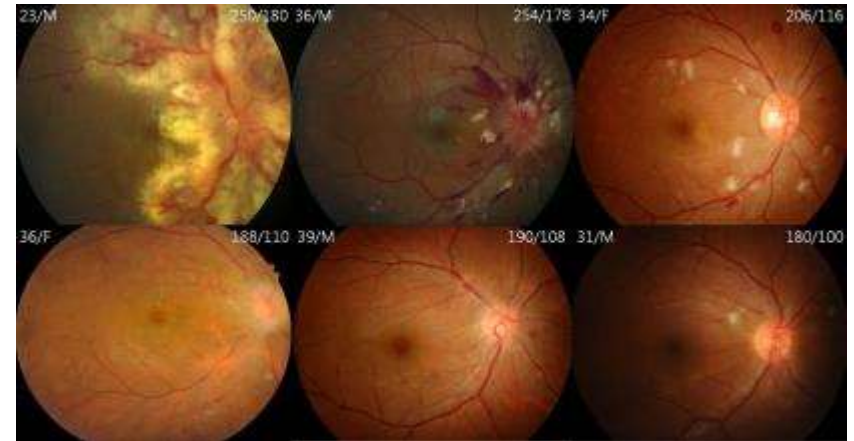
(Arterial) hypertension: masked hypertension



The term "masked hypertension" can be used to describe the contrasting to the white coat hypertension phenomenon, where a patient's blood pressure is above the normal range during daily living, although it isn't above the normal range when the patient is in a clinic setting

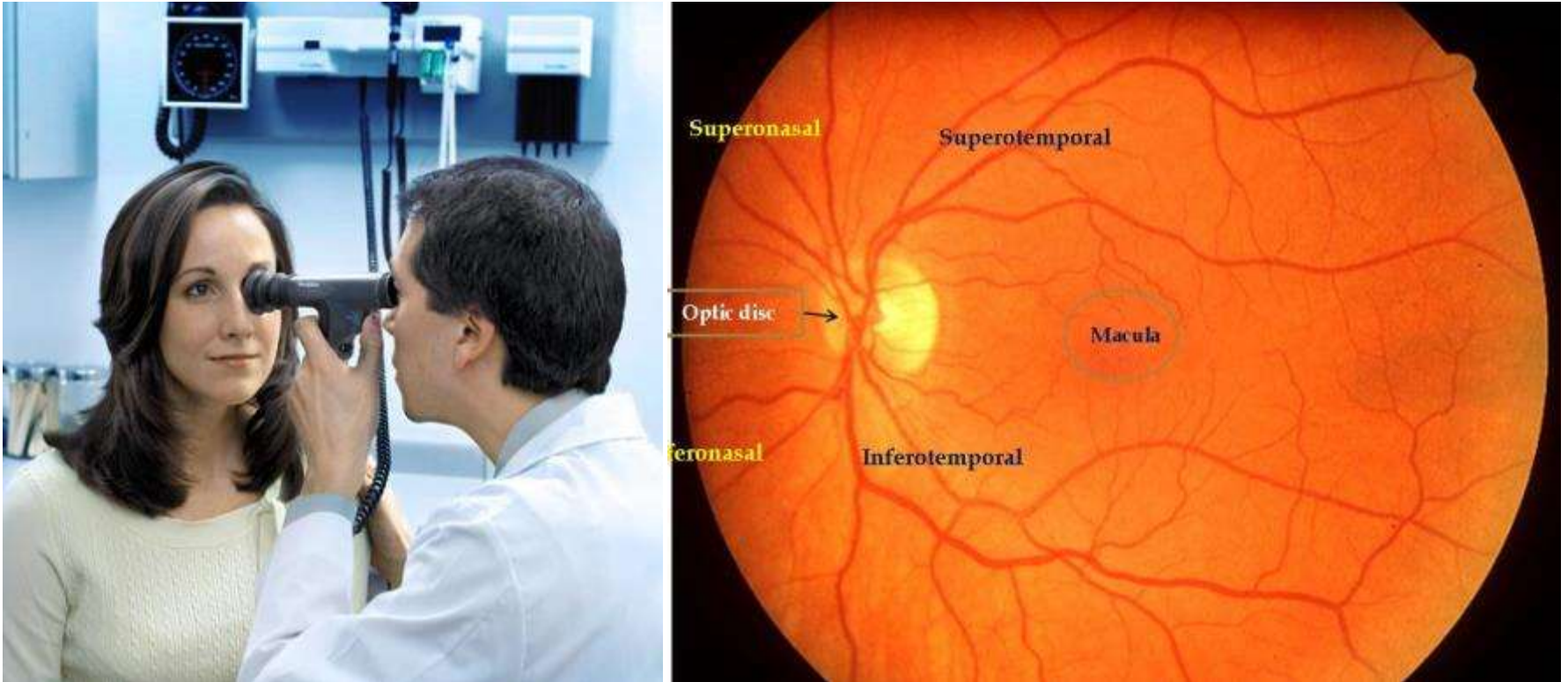
(Arterial) hypertension: Keith Wagener Barker (KWB) grades of hypertensive retinopathy

- Hypertensive retinopathy is damage to the retina and retinal circulation due to high blood pressure
- KWB grades:
 1. Arteriolar constriction/attenuation/sclerosis - `silver wiring` and vascular tortuosity
 2. As grade 1 + Irregularly located, tight constrictions - known as `AV nicking` or `AV nipping`
 3. As grade 2 + Retinal edema, cotton wool spots and flame-hemorrhages
 4. As grade 3 + swelling of the optic disc (papilloedema) + macular star



Peripapillary and periarteriolar retinal changes are apparent, including cotton wool spots, retinal hemorrhages, and exudates

(Arterial) hypertension: ophthalmoscopy



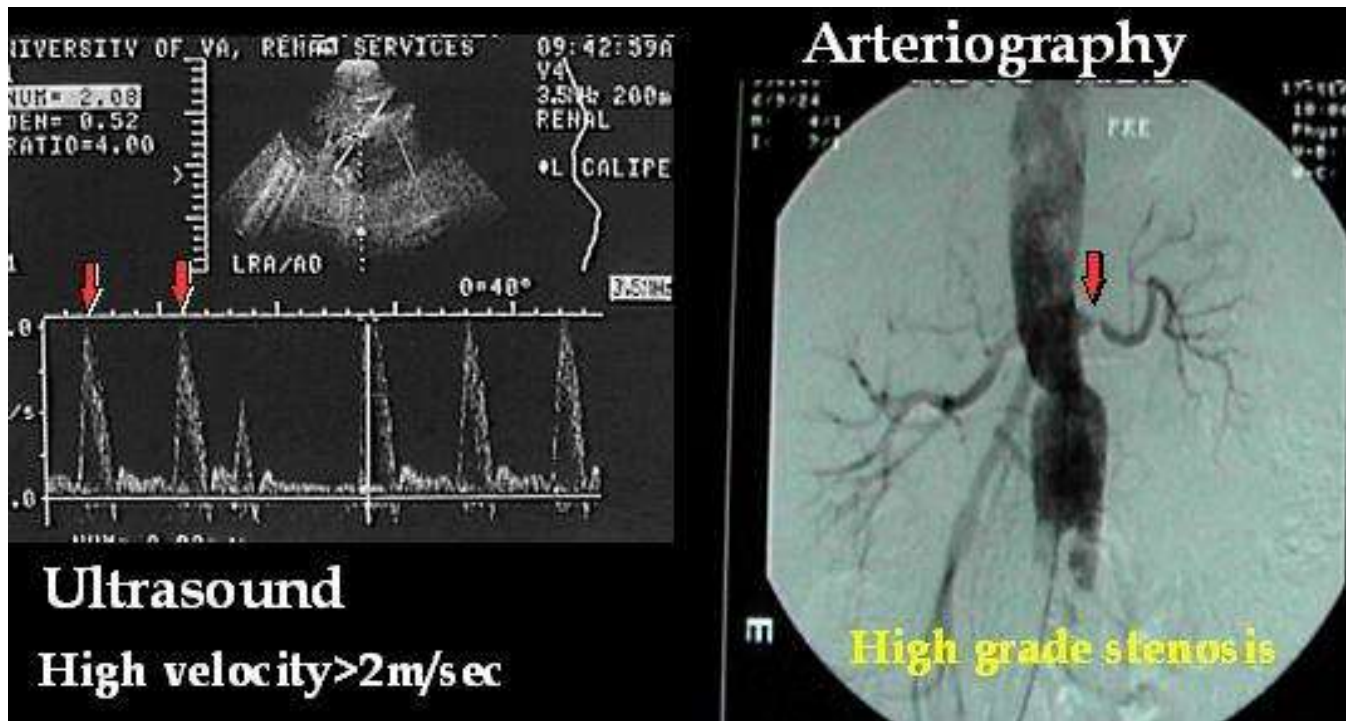
Normal Fundus

(Arterial) hypertension: renal sonography



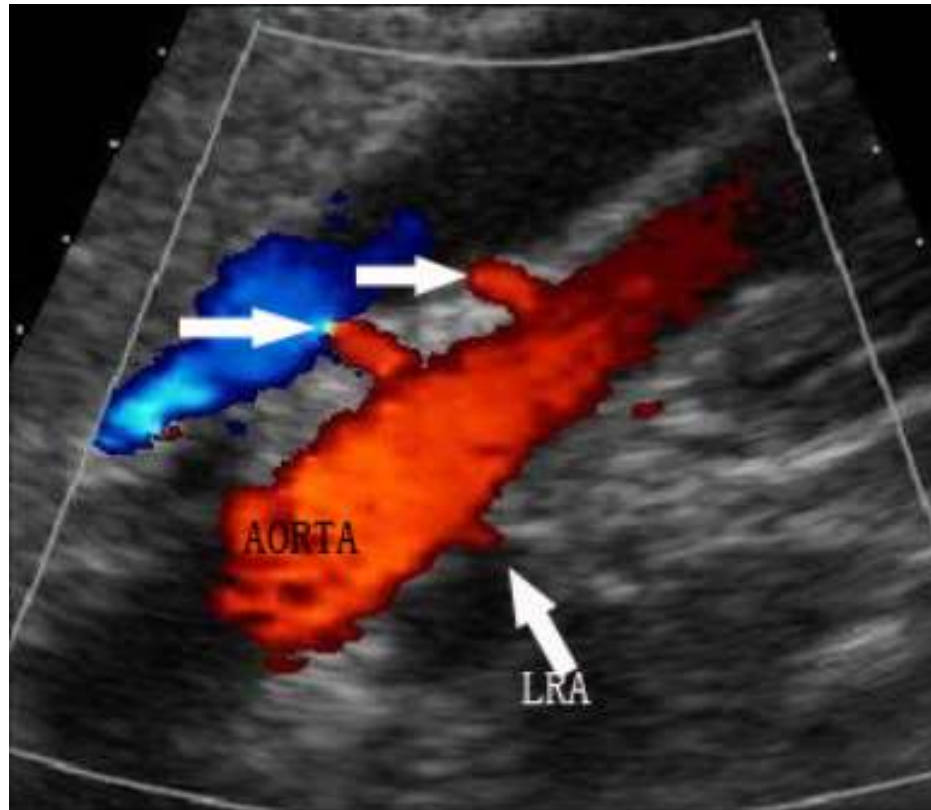
The size of the left kidney is small (8.37 cm in length) and echogenicity of the kidney is increased in a patient with left renal artery stenosis. LK, left kidney; SAG, sagittal view of the left kidney.

(Arterial) hypertension: combine renal artery Doppler ultrasound and arteriography



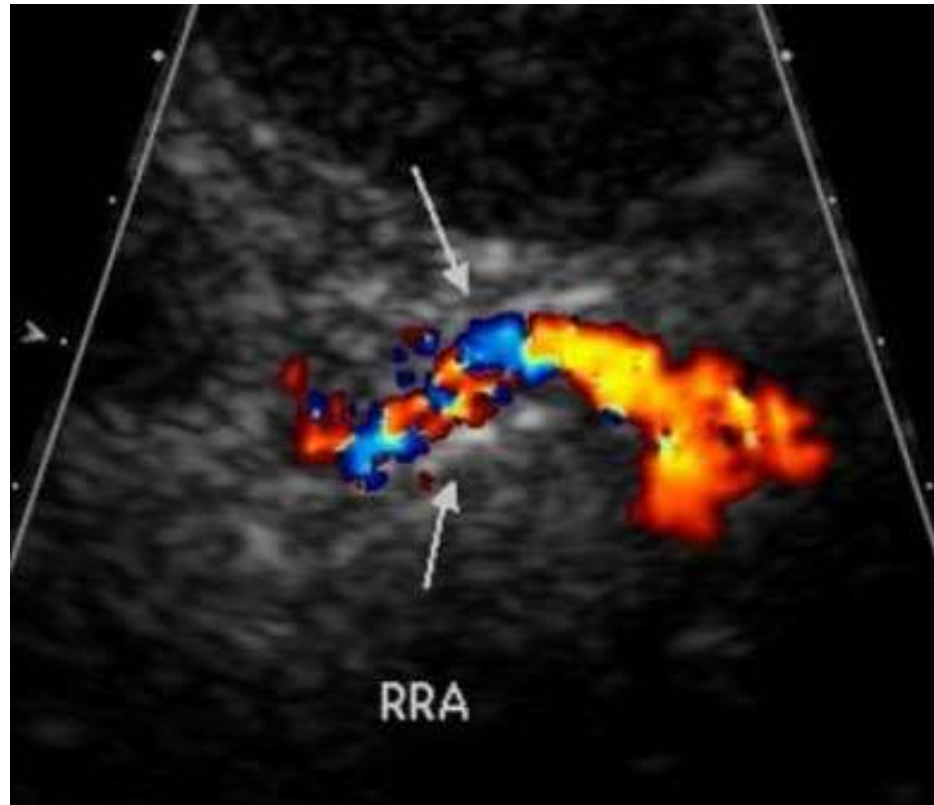
Renal artery Doppler ultrasound (1) screening for renal artery stenosis shows very high velocity flow at the level of the left renal artery origin from the aorta. This indicated a significant stenosis. (2) Subsequent arteriogram in same patient shows tight stenosis at the left renal artery ostium. Following angioplasty, the stenosis was gone and the patient's hypertension resolved.

(Arterial) hypertension: renal color duplex sonography



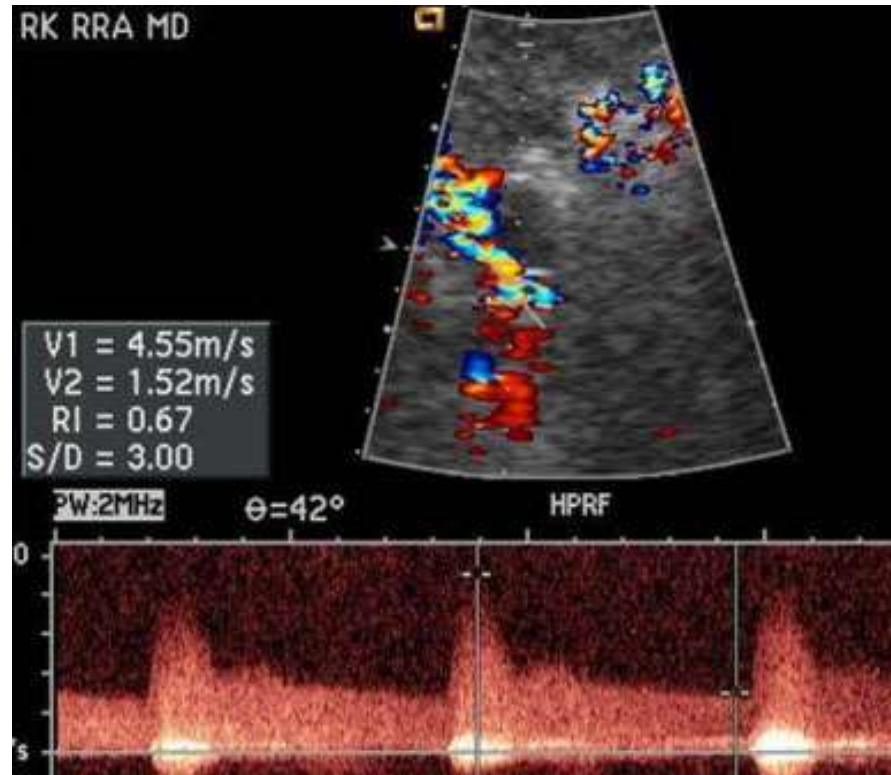
Normal appearance of the right renal artery, right accessory renal artery, single left renal artery (arrows), and abdominal aorta on longitudinal view of color flow image. LRA, left renal artery.

(Arterial) hypertension: renal color duplex sonography



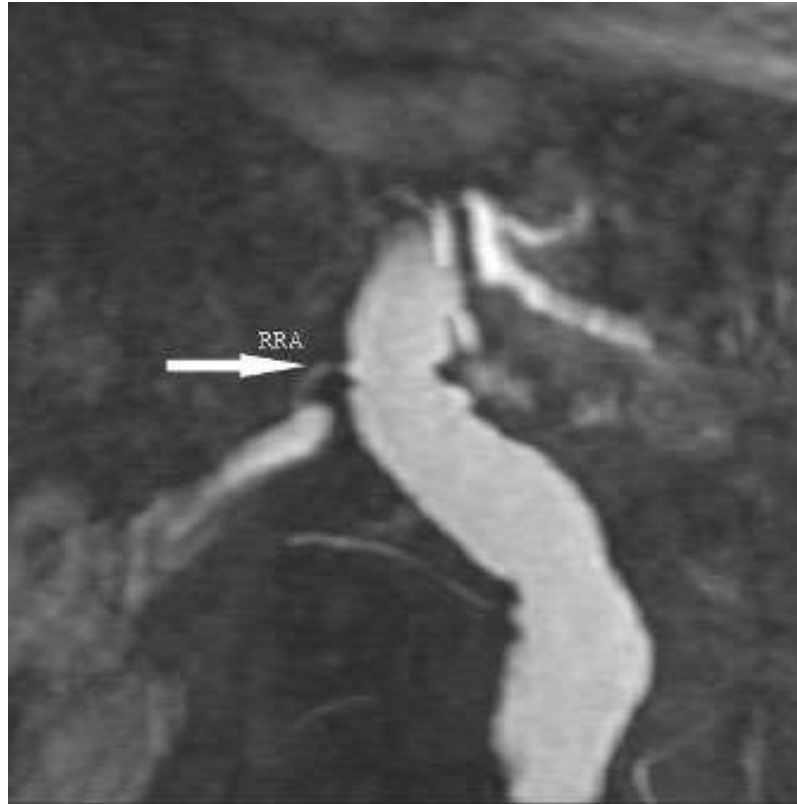
Remarkably turbulent flow at the stenosis of the right proximal renal artery on longitudinal view of color flow image.

(Arterial) hypertension: renal color duplex sonography



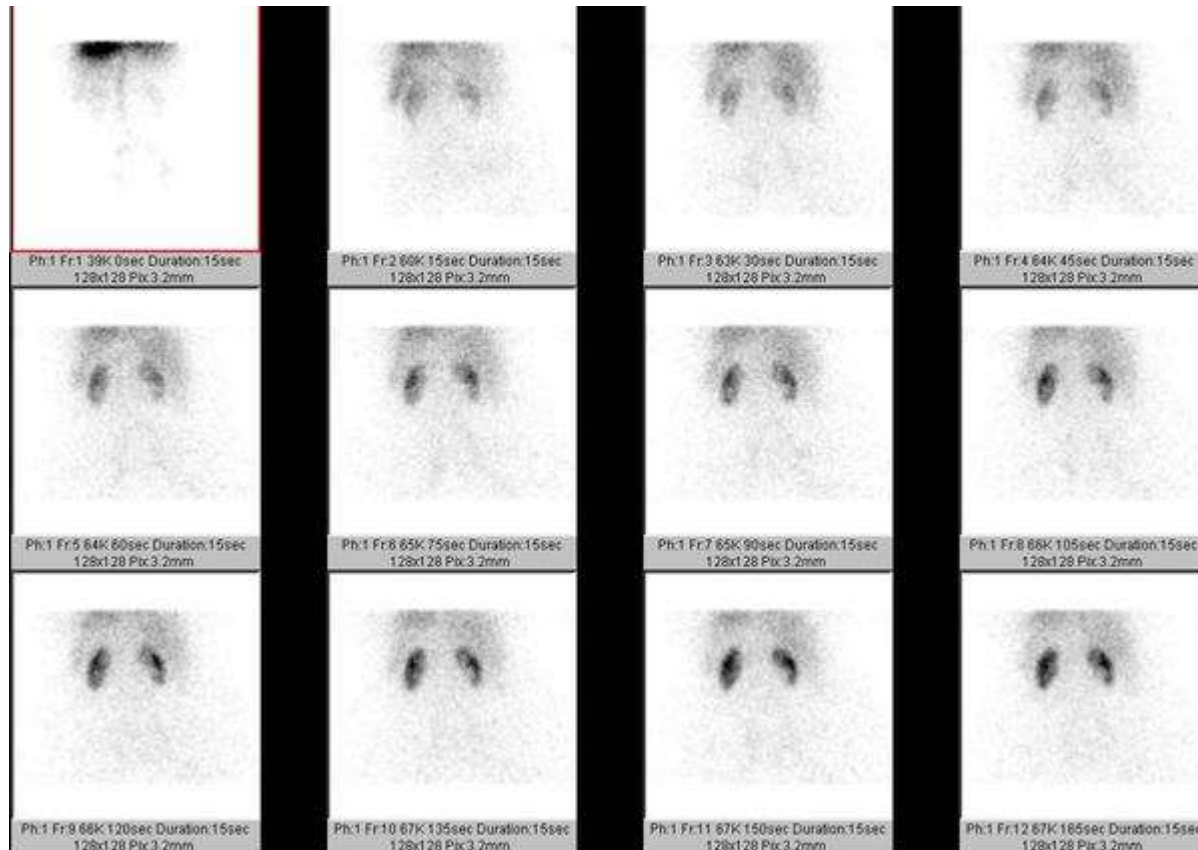
Spectral Doppler demonstrated high peak systolic velocity (6.27 m/s) at the right renal artery with hemodynamically significant stenosis.

(Arterial) hypertension: renal magnetic resonance imaging



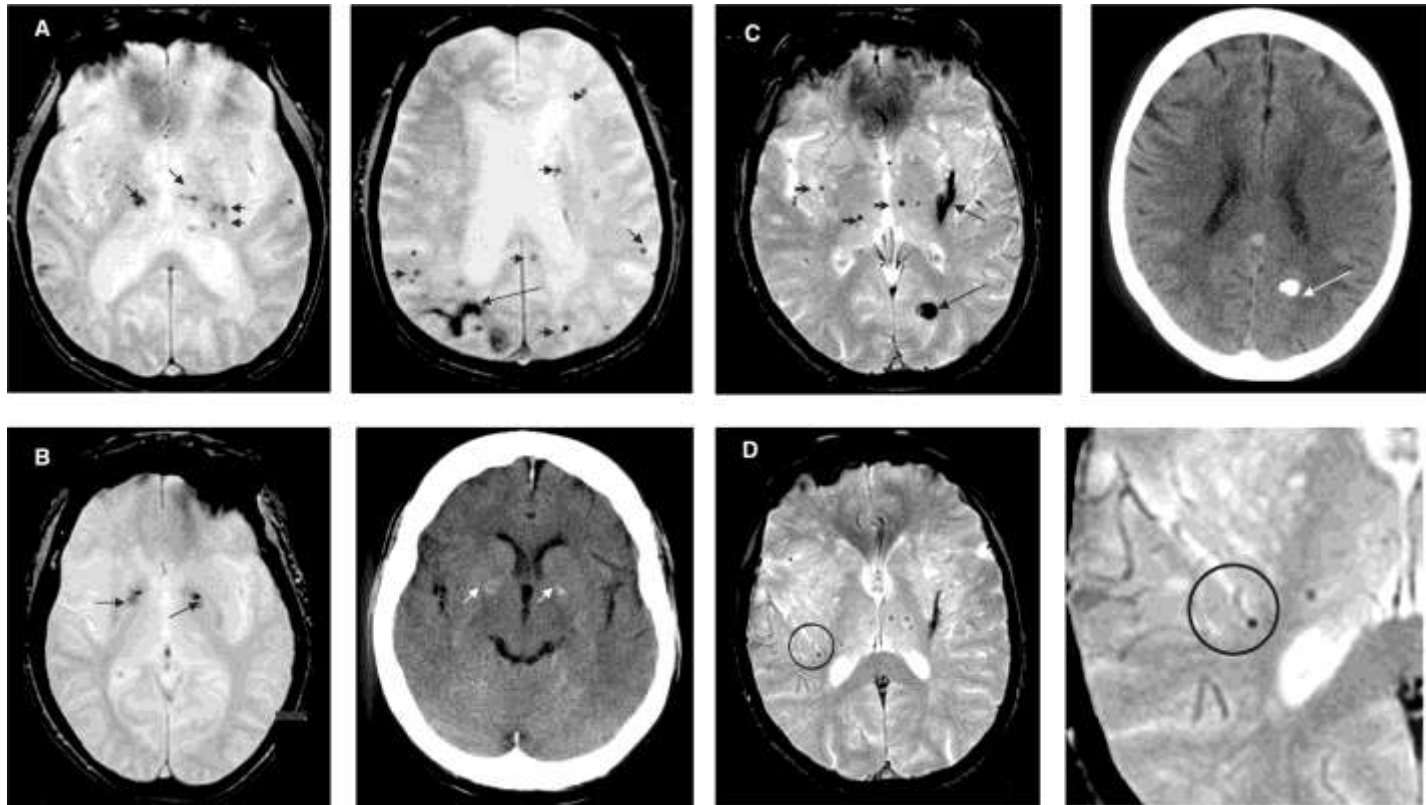
The stenosis at the right proximal renal artery.

(Arterial) hypertension: renal radionuclide imaging



Imaging of kidneys involves intravenous injection of tc mag3 (mercaptoacetyl triglycine) etc., and lying on table for hour or more while imaged by gamma camera

(Arterial) hypertension: brain magnetic resonance imaging



Brain microbleeds (BMBs) in arterial hypertension patient are seen as small, homogeneous, round foci of low signal intensity on magnetic resonance imaging gradient echo (GRE) T*2 sequences

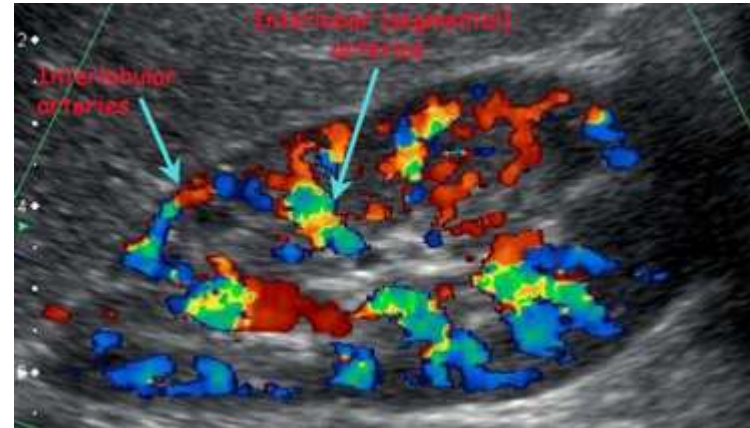
(Arterial) hypertension: chest x-ray



The x-ray chest is suggesting a definite LV enlargement

(Arterial) hypertension: indication for renal ultrasonography

- If urinalysis detects albuminuria (proteinuria), cylindruria, or microhematuria or if serum creatinine is elevated (≥ 1.4 mg/dL [$124 \mu\text{mol/L}$] in men; ≥ 1.2 mg/dL [$106 \mu\text{mol/L}$] in women), renal ultrasonography to evaluate kidney size may provide useful information

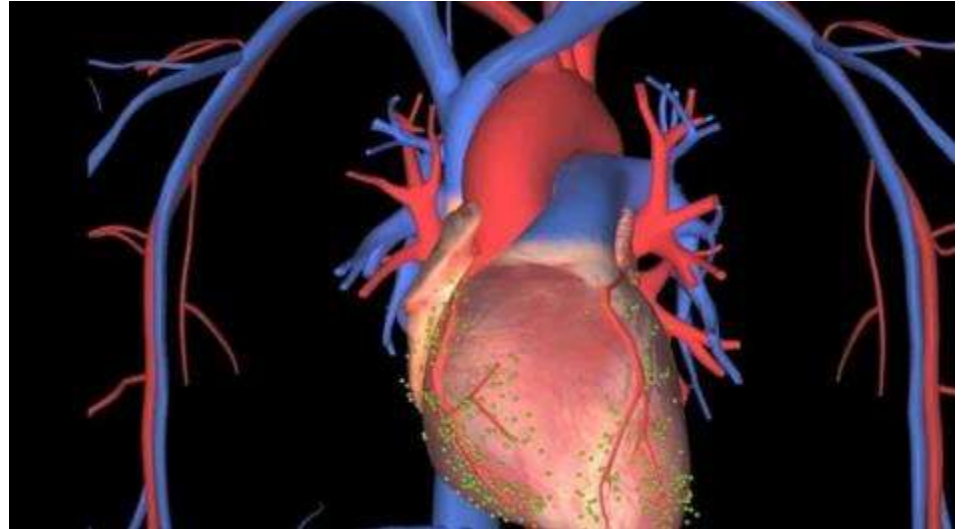


Normal renal arteries ultrasound.

Coronary insufficiency

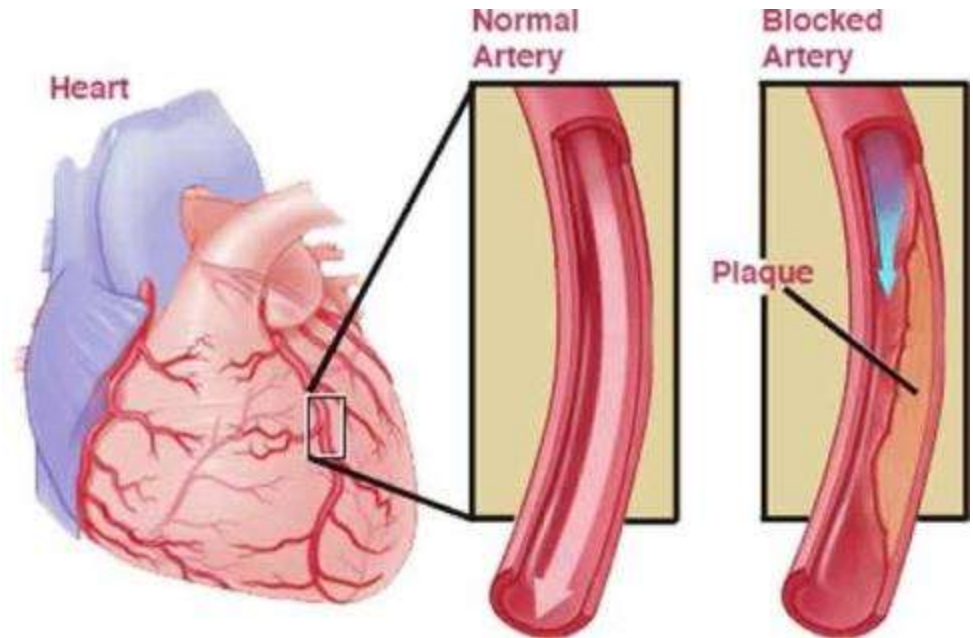
Coronary insufficiency: definition, types

- Coronary insufficiency (CI) is the state in which an imbalance occurs between the oxygen supply and demand, which prevents adequate maintenance of the metabolic needs of the myocardium, resulting in ischemia of several degrees of intensity
- Types: acute (acute coronary syndrome), chronic (stable angina)



Coronary insufficiency : causes

- Atherosclerotic obstructive coronary insufficiency (Coronary Artery Disease - CAD) –main cause
- Cardiac valvular diseases (aortic stenosis)
- Hypertrophic cardiomyopathy
- Microvasculature diseases (diabetes mellitus, syndrome X)
- Anomalous origin of coronary arteries, and coronary fistulas



Coronary occlusion.

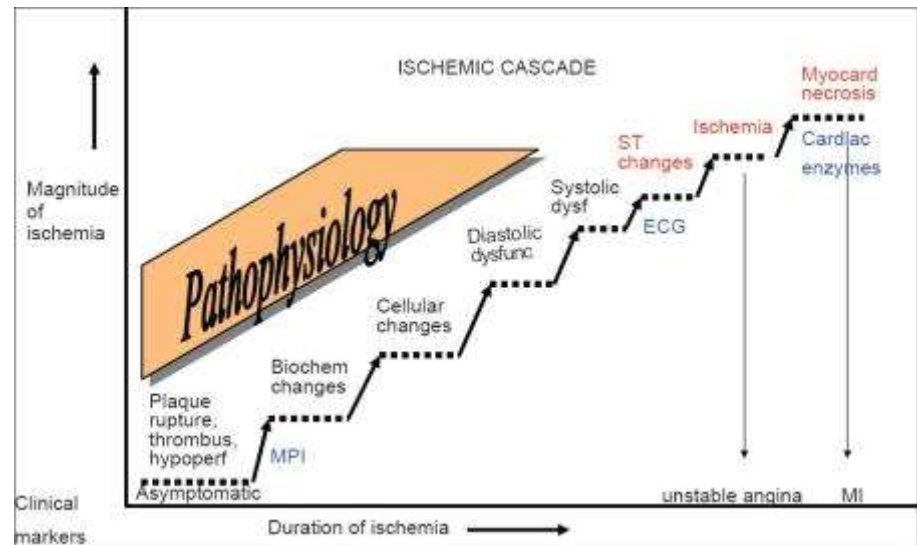
Coronary insufficiency: pathophysiology

The three fundamental components:

1. Endothelial dysfunction
2. Obstruction of the lumen of the vessel
3. Thrombosis at the location of the lesion

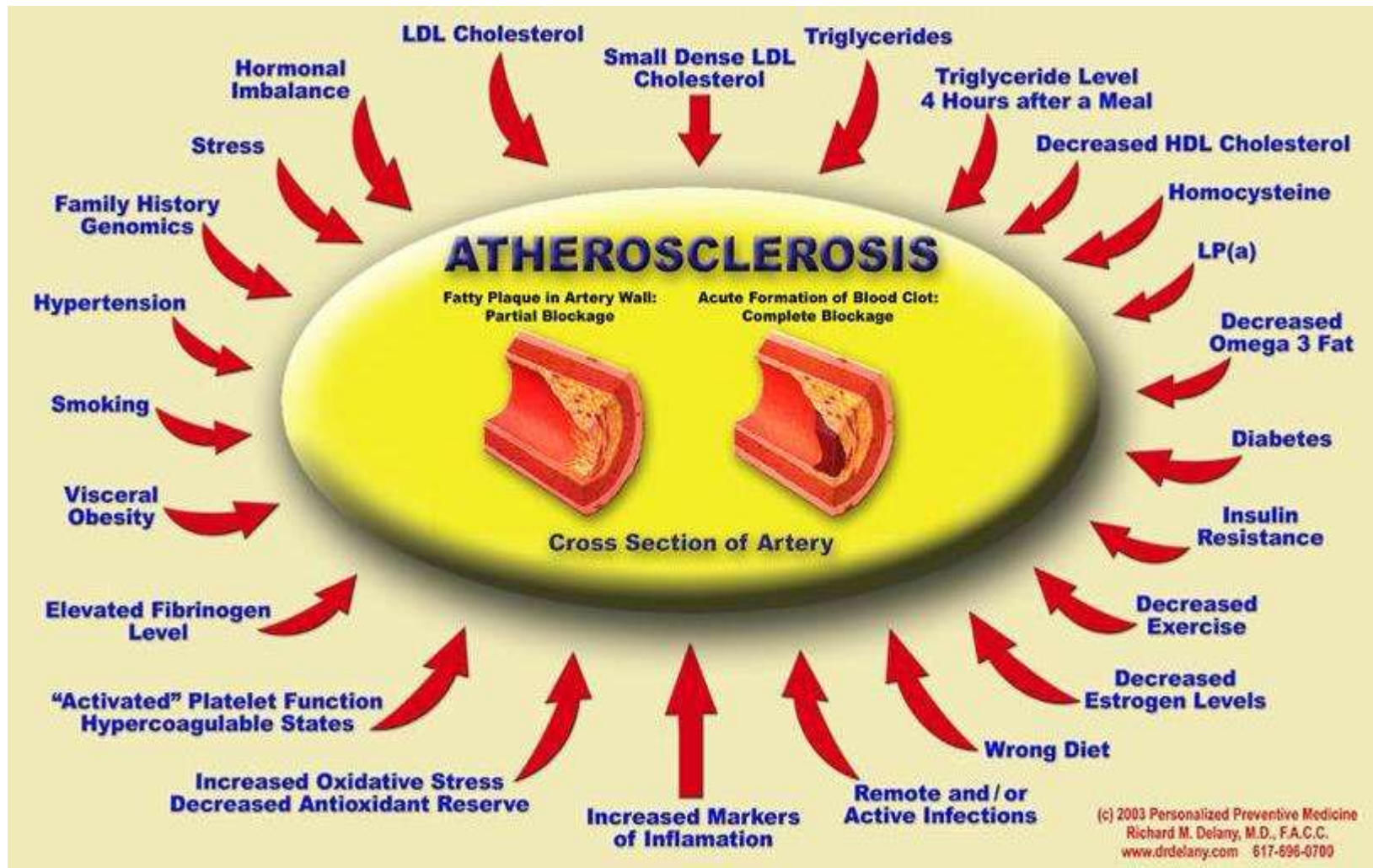
Any of the components could individually trigger coronary insufficiency, but they often occur at the same time

The decline of coronary reserve starts when lesions occupy at least 70% of the vessel diameter



Depicts the myocardial ischemic cascade and stepwise changes, which occur at molecular and tissue level.

Coronary insufficiency: risk factors



Coronary insufficiency: signs and symptoms

- Chest pain or discomfort
- Shortness of breath
- Heart failure
- Irregular heartbeat
- Nausea
- Sweating
- Decreased exercise tolerance
- Etc.



Coronary insufficiency: signs and symptoms (chest pain or discomfort)

But there is a disorder of the breast marked with strong and peculiar symptoms, considerable for the kind of danger belonging to it, and not extremely rare, which deserves to be mentioned more at length. The seat of it and the sense of strangling and anxiety with which it is attended, may make it not improperly be called angina pectoris. Those who are afflicted with it, are seized while they are walking (more especially if it be uphill, and soon after eating) with a painful and most disagreeable sensation in the breast, which seems as if it would extinguish life if it were to increase or to continue; but the moment they stand still, all this uneasiness vanishes. In all other respects, the patients are, at the beginning of this disorder, perfectly well, and in particular have no shortness of breath, from which it is totally different. The pain is sometimes situated in the upper part, sometimes in the middle, sometimes in the bottom of the os sterni, and often more inclined to the left than to the right side. It likewise very frequently extends from the breast to the middle of the left arm.



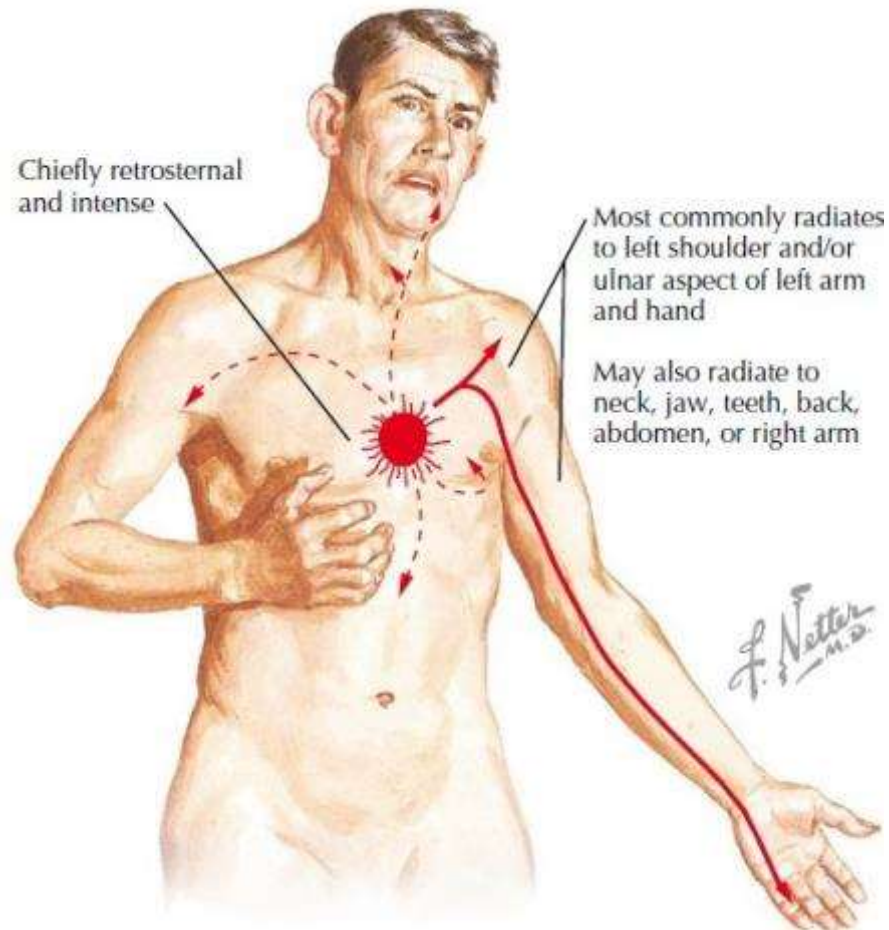
WILLIAM HEBERDEN, 1772

Coronary insufficiency: signs and symptoms (chest pain or discomfort)

Nomenclature and Criteria for Diagnosis of Diseases of the Heart and Blood Vessels, 1953

In this syndrome the major symptom is thoracic pain, which is precipitated usually by effort but sometimes by excitement, a heavy meal or exposure to cold. The pain is usually substernal or just to the left of the sternum. Occasionally the pain is epigastric and in rare instances it may be localized in the neck or the left arm or shoulder. There is a tendency for the pain to radiate, most frequently to the left shoulder and arm and occasionally to the fingers. Less frequently it may radiate to the neck, jaw and teeth, to the back, upper abdomen, or to the right shoulder and arm. At times the pain will start at one of these points before focusing on the anterior surface of the chest. The intensity varies from a slight sense of heaviness to a severe crushing pain. Since the precipitating cause is commonly physical exertion, rest usually causes the pain to subside. The length of the episode, therefore, is relatively short. Occasionally an attack may come on while the patient is at rest or even when asleep. The pain is often accompanied by a sense of choking or inability to breathe which is also relieved by rest. The patient will often complain of flatulence as well. If the attack is not relieved by rest or a nitrite and lasts for an hour or more, and especially if it is accompanied by circulatory collapse, myocardial infarction should be strongly suspected. Occasionally the pain of myocardial infarction may be identical with the pain of the anginal syndrome. The associated symptomatology and the subsequent course will determine the diagnosis.

Coronary insufficiency: signs and symptoms (chest pain or discomfort)



Coronary insufficiency: signs and symptoms (chest pain or discomfort)

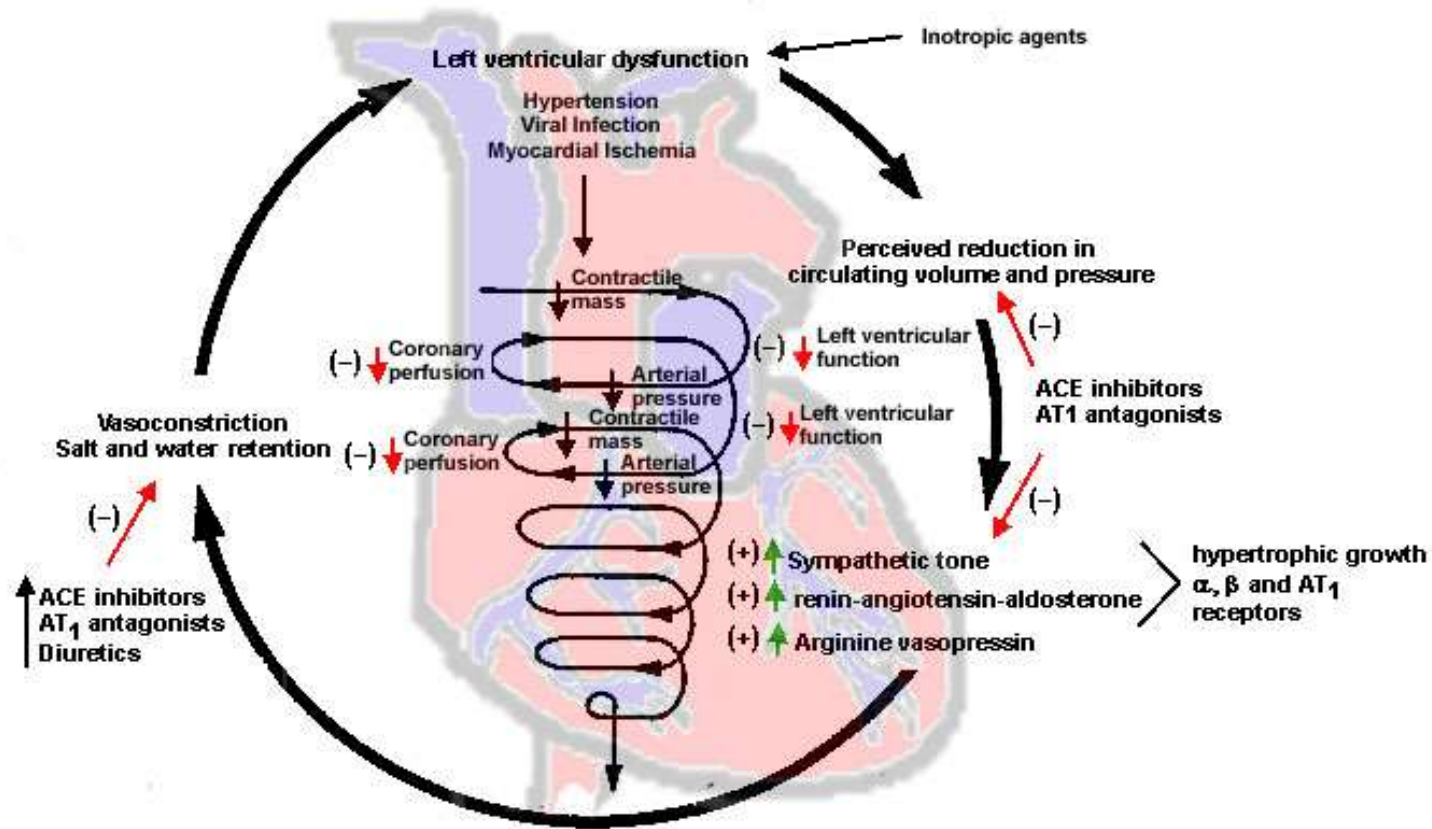
Pain (Chest)	Cardiac	Pleuritic	Traumatic
D Description: <ul style="list-style-type: none"> Can you describe the pain to me? (You need to determine it's nature.) Is it there all the time? Does it come and go? Have you ever had this pain before? What was it that time? 	<ul style="list-style-type: none"> Bloody Tight Squeezing Dull 	<ul style="list-style-type: none"> Sharp Catching Stabbing 	<ul style="list-style-type: none"> Sharp Catching Stabbing
O Onset: <ul style="list-style-type: none"> When did it start? What were you doing at the time? Did it come only suddenly or slowly? 	<ul style="list-style-type: none"> Gradual (Angina) Sudden (UA/Infarct) With Exercise (Angina) At Rest (UA/Infarct) 	<ul style="list-style-type: none"> Gradual (Infection) Sudden (Pneumothorax) 	<ul style="list-style-type: none"> Gradual (post trauma) Sudden (post trauma)
L Location: <ul style="list-style-type: none"> Take one finger and point to the pain? Does it extend anywhere else? If well localised palpate and visualise 	<ul style="list-style-type: none"> Poorly localised Chest to back to jaw Barely changes with palpation 	<ul style="list-style-type: none"> Well localised Usually chest wall Usually changes with palpation / ventilation 	<ul style="list-style-type: none"> Well defined Usually chest wall Changes with palpation / ventilation
O Other Signs and Symptoms: <ul style="list-style-type: none"> "Do you feel nauseous?" If yes "Have you vomited?" "Do you feel SOB?" "Have you noticed palpitations?" "What came first, the discomfort or the SOB?" 	<ul style="list-style-type: none"> SOB % Diaphoretic % Palpitations % 	<ul style="list-style-type: none"> SOB (on exertion) Chest infection (prodromal) 	<ul style="list-style-type: none"> SOB (on exertion)
R Relief: <ul style="list-style-type: none"> "Have you taken anything for the discomfort?" If yes "Has it helped?" "Does it usually?" "Does taking a deep breath make the pain better, worse or no different?" "Does moving make the pain better, worse or no different?" 	<ul style="list-style-type: none"> Relieved with Nitrates (Angina) Unrelieved with Nitrates (UA/Infarct) Poor relief with NSAIDS Poor relief with position 	<ul style="list-style-type: none"> Unrelieved with Nitrates Mild relief with NSAIDS Some relief with position 	<ul style="list-style-type: none"> Unrelieved with Nitrates Mild relief with NSAIDS Some relief with position

Coronary insufficiency: signs and symptoms (shortness of breath)



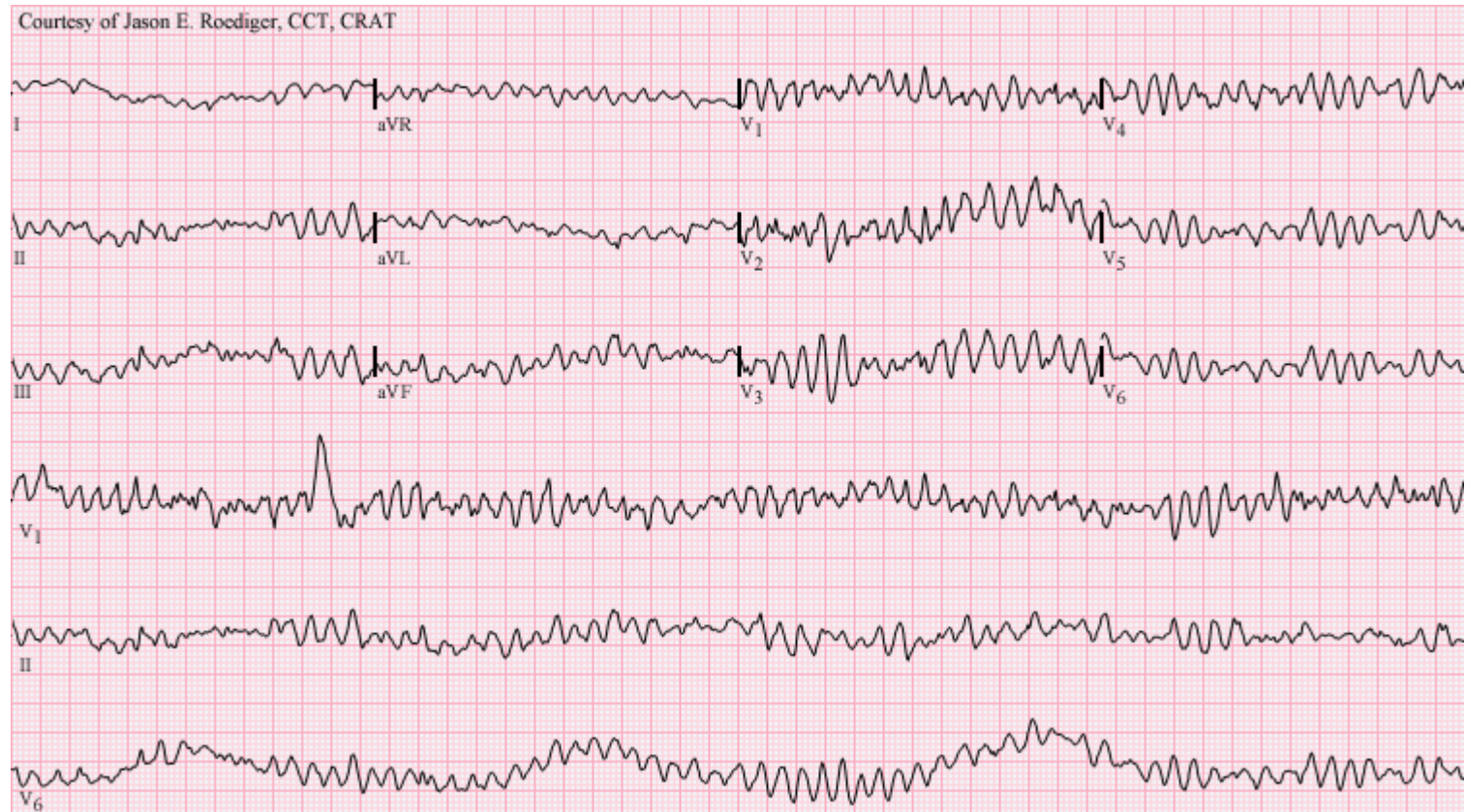
A man experiences shortness of breath.

Coronary insufficiency: signs and symptoms (heart failure)



An overview of heart failure and its treatment.

Coronary insufficiency: signs and symptoms (irregular heartbeat)



Ventricular fibrillation.

Coronary insufficiency: signs and symptoms (nausea)



Coronary insufficiency: signs and symptoms (sweating)



Coronary insufficiency :

acute

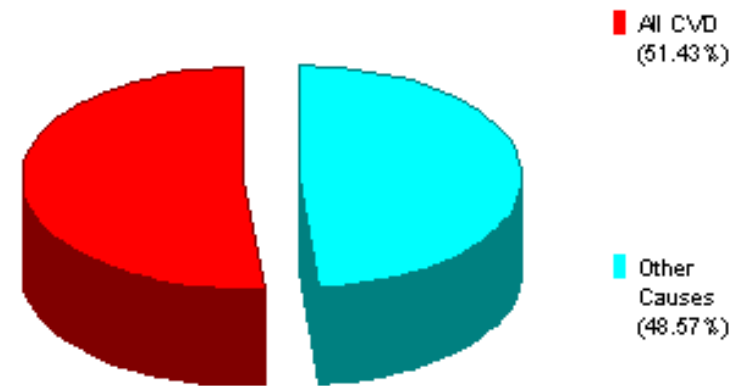
- Acute coronary insufficiency (acute coronary syndrome (ACS)) refers to a group of conditions due to decreased blood flow in the coronary arteries such that part of the heart muscle is unable to function properly or dies
- These types are named according to the appearance of the electrocardiogram (ECG/EKG):
 - Non-ST segment elevation myocardial infarction (NSTEMI)
 - ST- segment elevation myocardial infarction (STEMI)
- Acute coronary insufficiency should be distinguished from stable angina, which develops during exertion and resolves at rest
- In contrast with stable angina, unstable angina occurs suddenly, often at rest or with minimal exertion, or at lesser degrees of exertion than the individual's previous angina ("crescendo angina")
- New onset angina is also considered unstable angina, since it suggests a new problem in a coronary artery

Coronary insufficiency: chronic

- Chronic coronary insufficiency (stable angina (angina pectoris, angina)) is the sensation of chest pain, pressure, or squeezing, often due to ischemia of the heart muscle from obstruction or spasm of the coronary arteries
- The term derives from the Latin angere ("to strangle")
- There is a weak relationship between severity of pain and degree of oxygen deprivation in the heart muscle
- Worsening ("crescendo") angina attacks, sudden-onset angina at rest, new onset effort angina and angina lasting more than 15 minutes are symptoms of unstable angina (sudden-onset angina at rest and angina lasting more than 15 minutes usually grouped with similar conditions as the acute coronary syndrome)

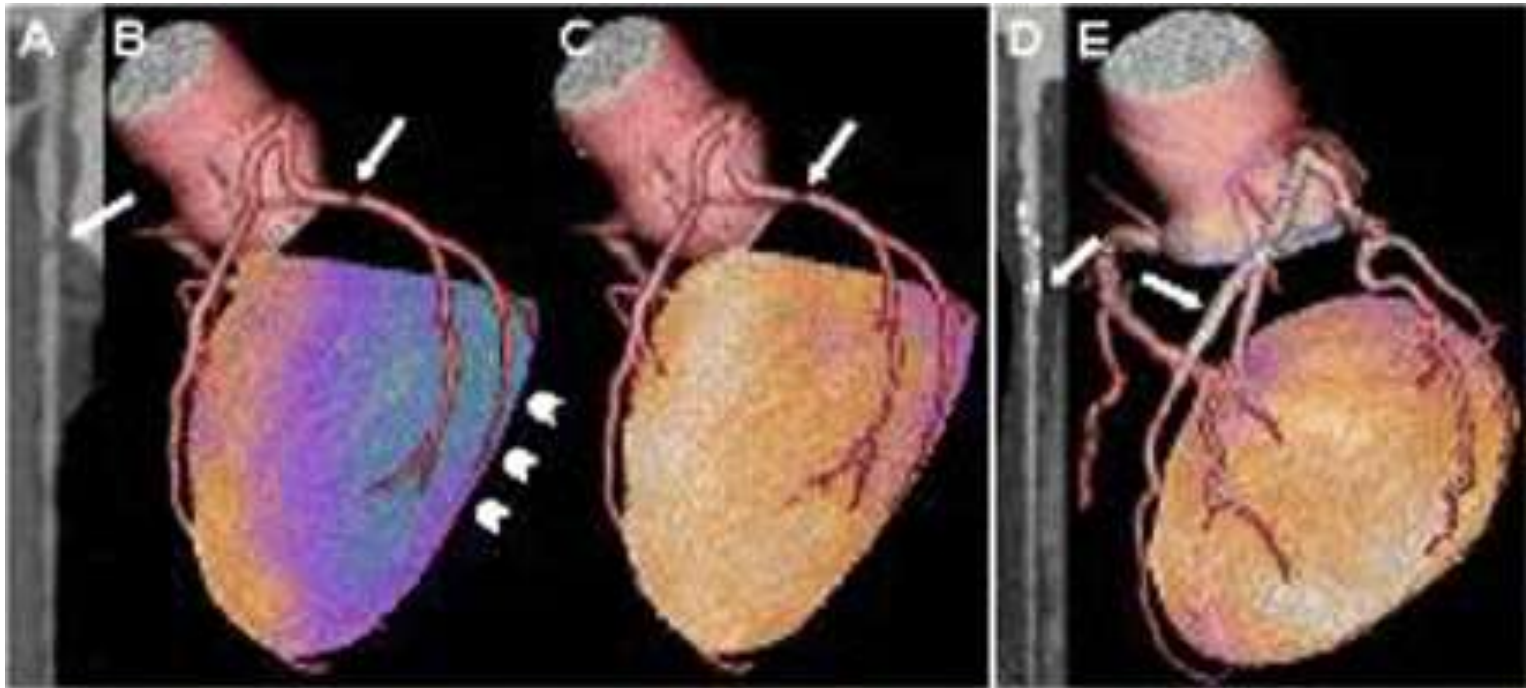
Coronary insufficiency: chronic (symptoms)

- Occurs when the heart must work harder, usually during physical exertion
- Doesn't come as a surprise, and episodes of pain tend to be alike
- Usually lasts a short time (5 minutes or less)
- Is relieved by rest or medicine
- May feel like gas or indigestion
- May feel like chest pain that spreads to the arms, back, or other areas
- May be associated with fear of dying



Other specified forms of chronic ischemic heart disease

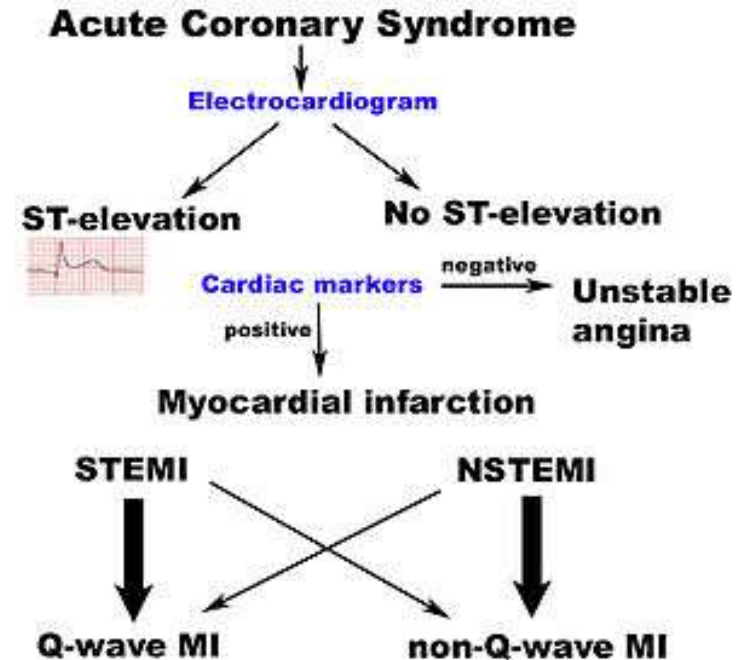
Coronary insufficiency : syndromes (silent ischemia)



Patient with silent ischemia. Cardiac hybrid imaging integrating single-photon emission computed tomography with computed tomography coronary angiography.

Coronary insufficiency: diagnosis

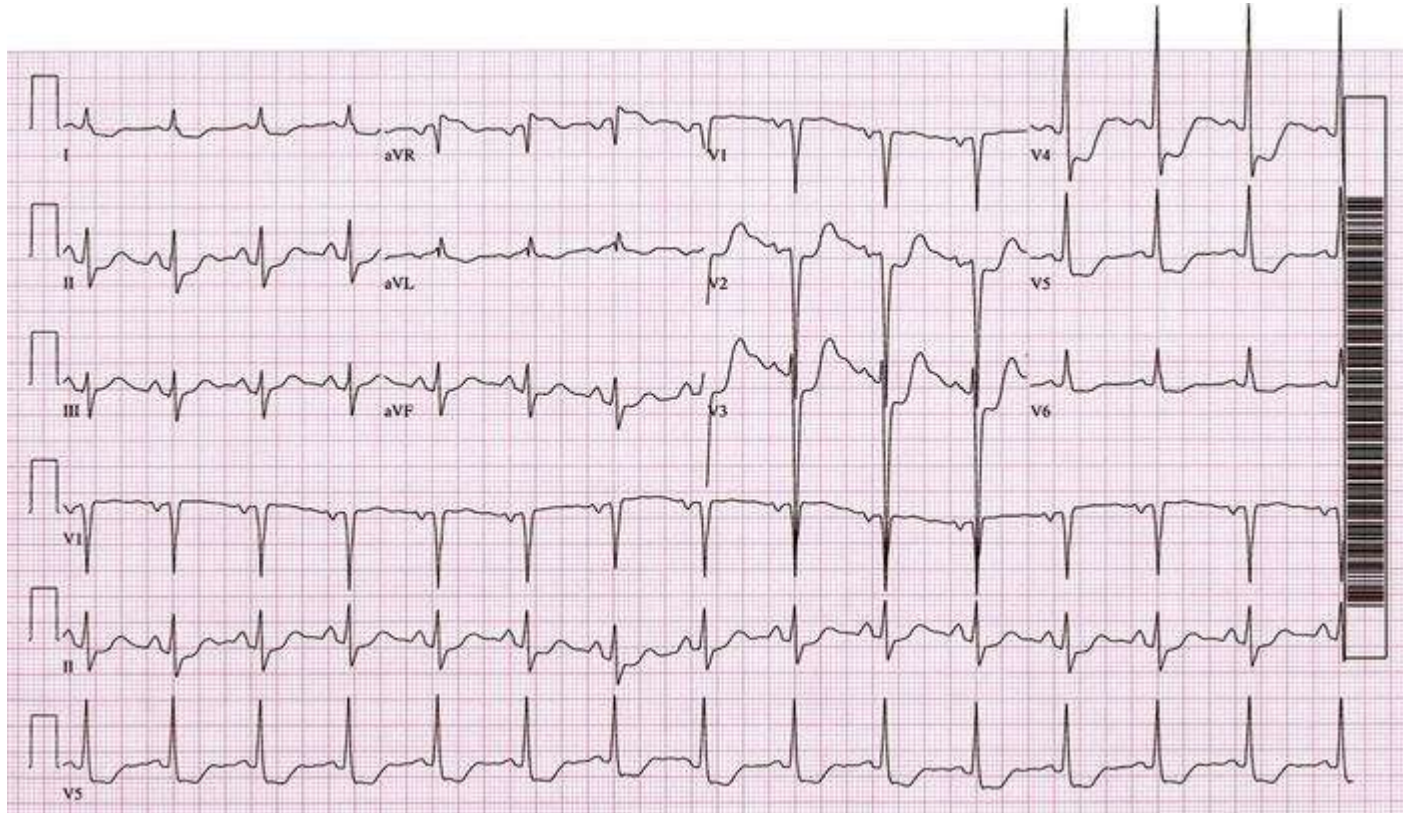
- Electrocardiography
- Stress test
- Echocardiography (including stress echocardiography and intravascular ultrasound)
- Coronary angiography
- Exercise radioisotope test (nuclear stress test, myocardial scintigraphy)
- Radioisotopes
- Magnetic resonance imaging
- Computed tomography
- Blood Test



Diagnostics algorithm:

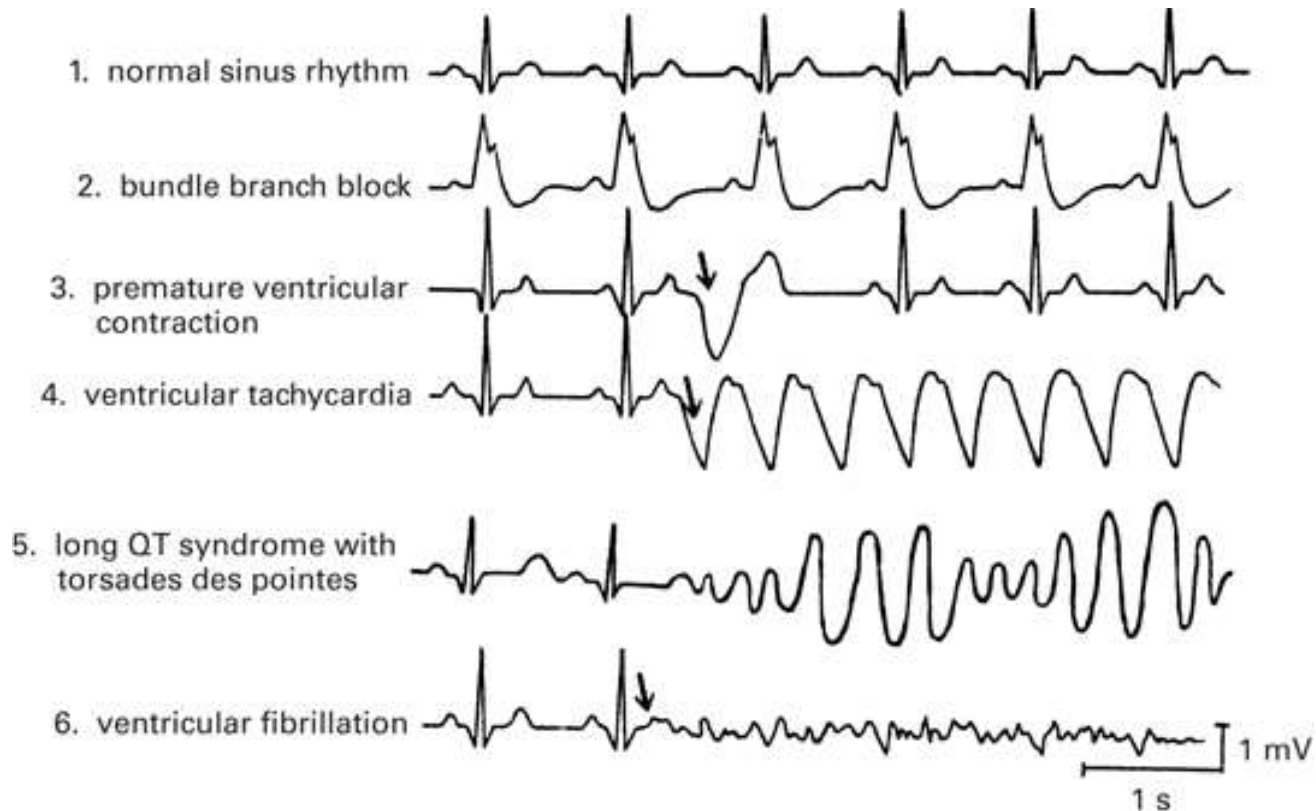
STEMI ST-elevation Myocardial Infarction,
NCTEMI – No ST-elevation Myocardial
Infarction

Coronary insufficiency: diagnosis (electrocardiography)



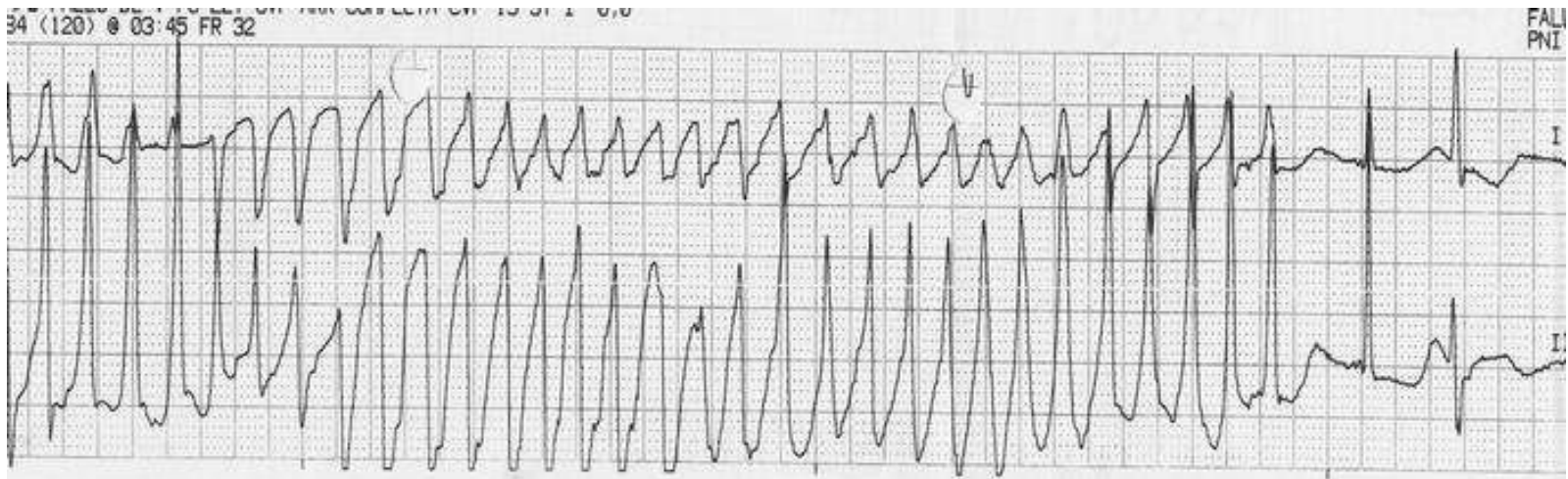
A 12-lead electrocardiograph of ischemic anterolateral ST-segment depression in a patient with known coronary artery disease.

Coronary insufficiency: diagnosis (electrocardiography)



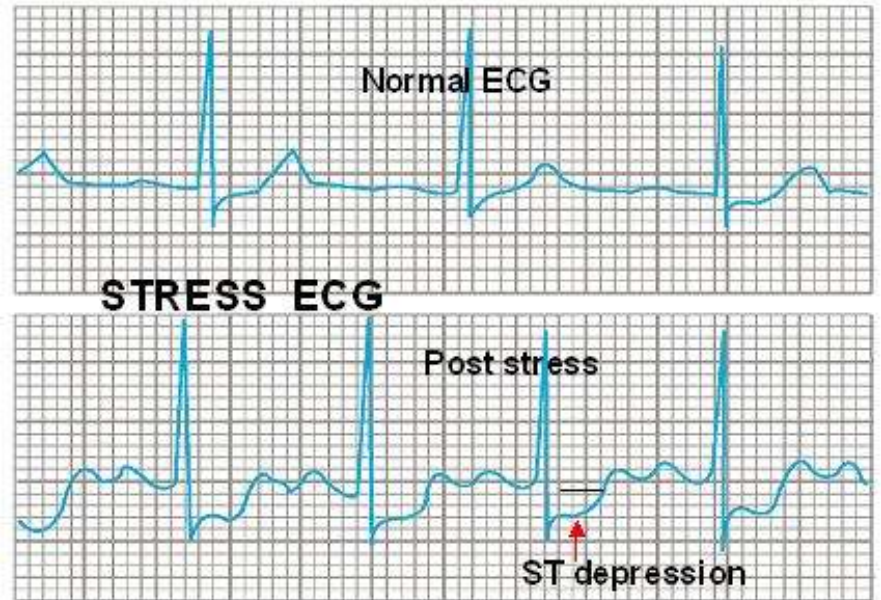
Ventricular arrhythmias.

Coronary insufficiency: diagnosis (electrocardiography)



Polymorphic ventricular tachycardia in torsade de pointes.

Coronary insufficiency: diagnosis (stress test)



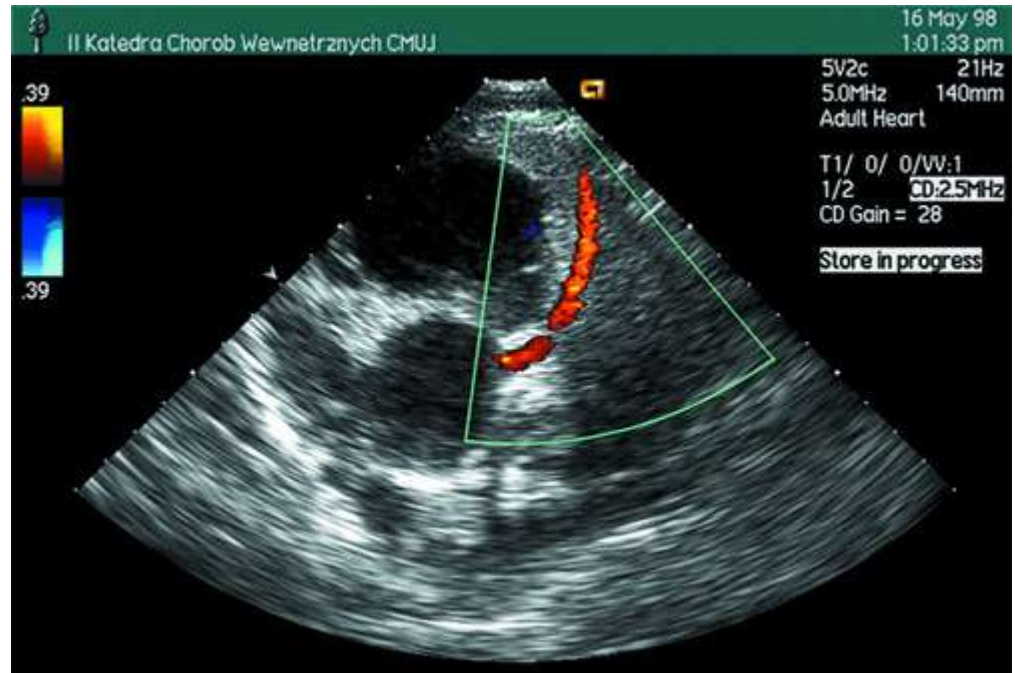
ST-segment depression confirms ischemia and positive stress test

Coronary insufficiency: diagnosis (Canadian Cardiovascular Society Functional Classification of Angina Pectoris)

Class	Definition	Specific Activity Scale
I	Ordinary physical activity (eg, walking and climbing stairs) does not cause angina; angina occurs with strenuous, rapid, or prolonged exertion at work or recreation.	Ability to ski, play basketball, jog at 5 mph, or shovel snow without angina
II	Slight limitation of ordinary activity. Angina occurs on walking or climbing stairs rapidly, walking uphill, walking or stair climbing after meals, in cold, in wind, or under emotional stress, or only during the few hours after awakening, when walking more than 2 blocks on level ground, or when climbing more than 1 flight of stairs at a normal pace and in normal conditions.	Ability to garden, rake, roller skate, walk at 4 mph on level ground, have sexual intercourse without stopping
III	Marked limitation of ordinary physical activity. Angina occurs on walking 1 to 2 blocks on level ground or climbing 1 flight of stairs at a normal pace in normal conditions.	Ability to shower or dress without stopping, walk 2.5 mph, bowl, make a bed, play golf
IV	Inability to perform any physical activity without discomfort.	Anginal symptoms may be present at rest. Inability to perform activities requiring 2 or fewer metabolic equivalents without angina

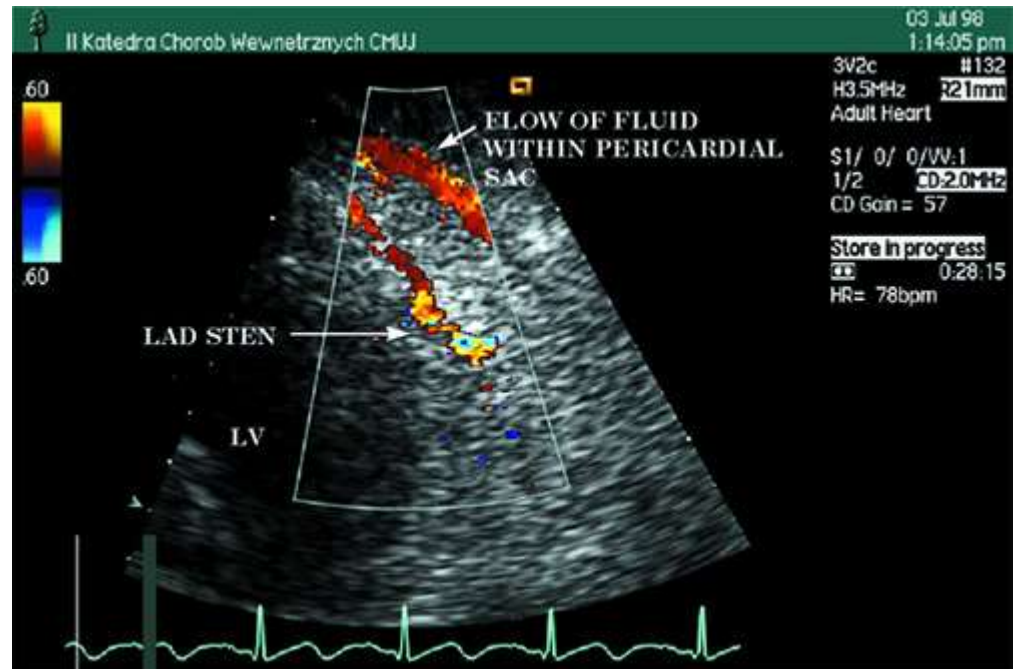
Coronary insufficiency : diagnosis (echocardiography)

Left main stem coronary artery and proximal segment of left anterior descending coronary artery (LAD) in color-coded transthoracic Doppler echocardiography



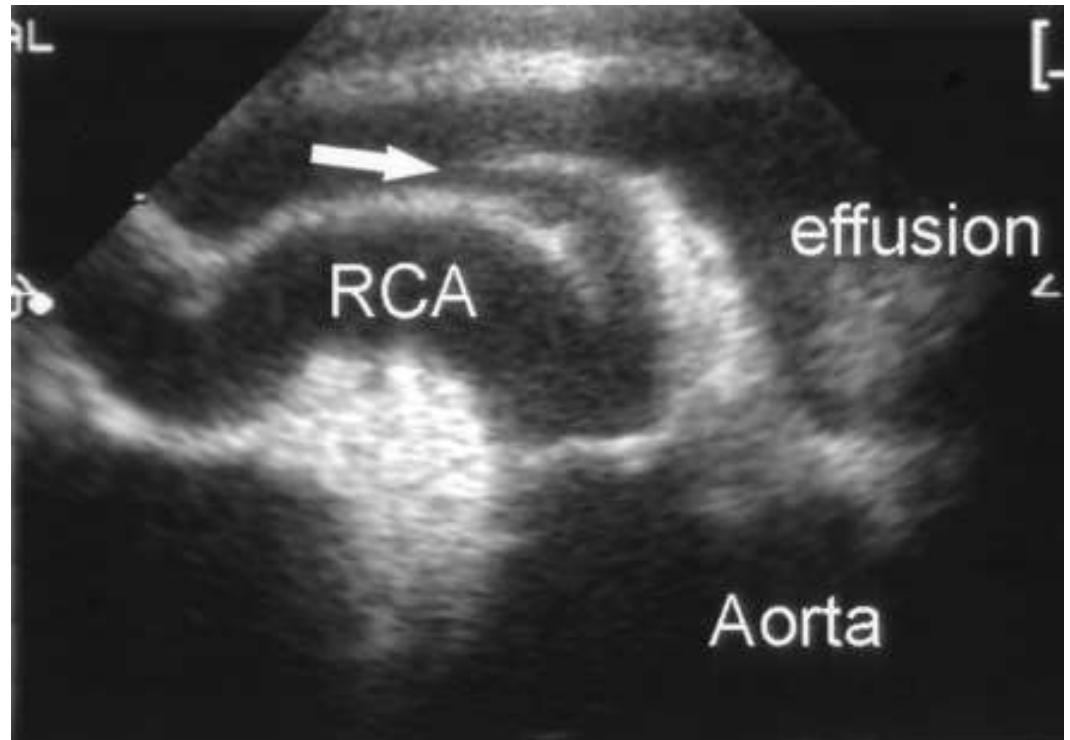
Coronary insufficiency : diagnosis (echocardiography)

- Direct visualization of coronary artery stenosis
- The portion of mid segment of left anterior descending coronary artery (LAD) with color mosaic (a sign of high-velocity, turbulent flow) at stenotic site



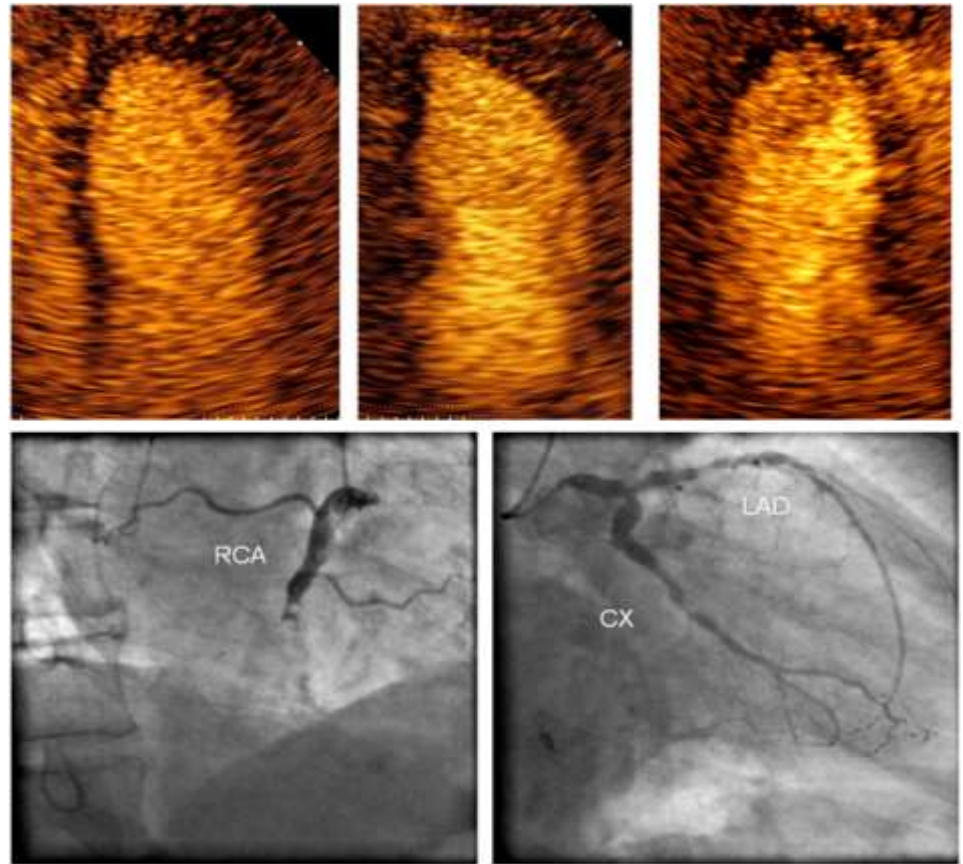
Coronary insufficiency : diagnosis (echocardiography)

- Echocardiography, parasternal short-axis view
- In presence of pericardial effusion, proximal part of right coronary artery (RCA) is suspicious for dissection (arrow). Imaging plane is off axis of nondilated RCA ostium



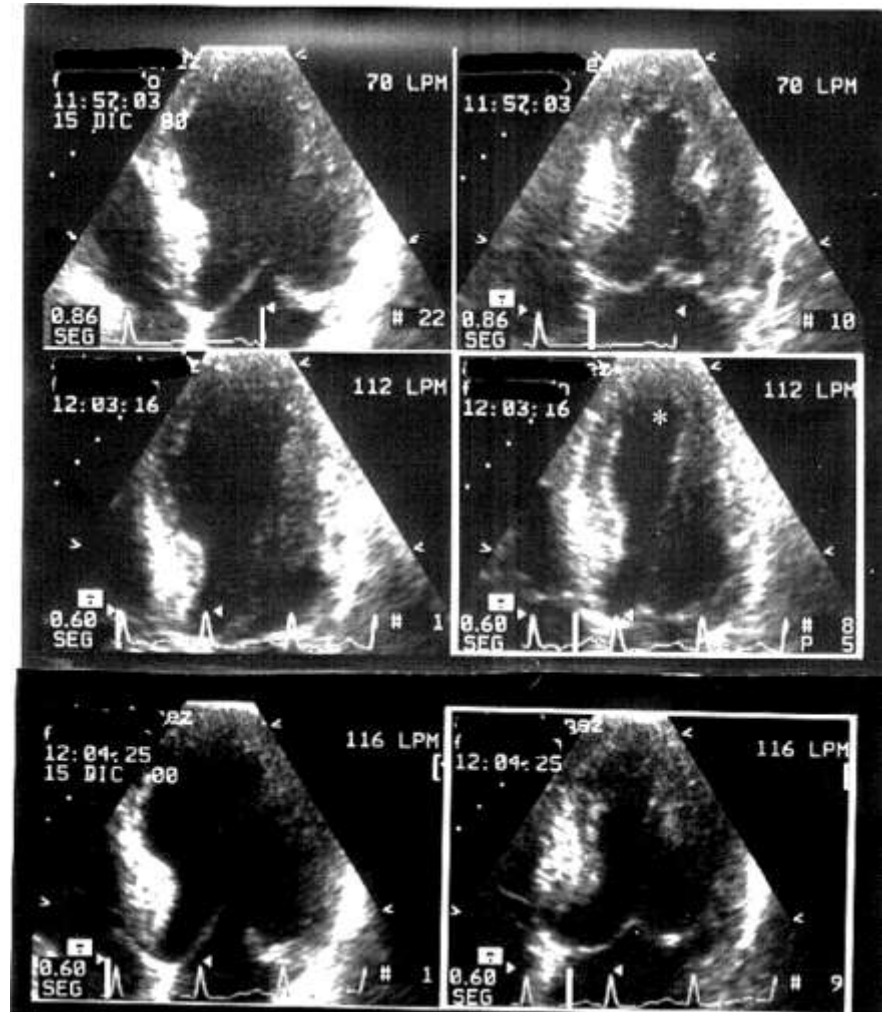
Coronary insufficiency : diagnosis (echocardiography)

Contrast echocardiography in apical 4-chamber, 2-chamber and 3-chamber views (upper panels) demonstrating the extensive reduction of myocardial perfusion in a non ST-elevation myocardial infarction (NSTEMI) patient with angiographic triple-vessel disease including acute occlusion of the right coronary artery and left main stem stenosis (lower panels)



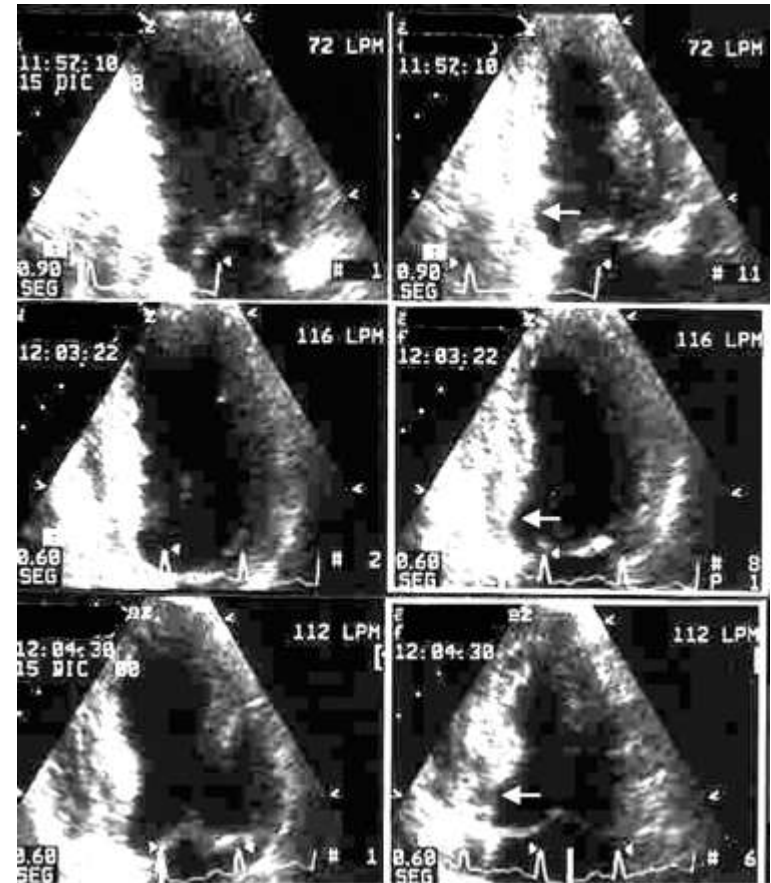
Coronary insufficiency : diagnosis (stress echocardiography)

- Four-chamber diastolic (left) and systolic (right) apical frames at rest (top), peak (middle) and post-exercise (bottom) imaging in a patient with a history of previous inferior infarction and showed three-vessel disease on coronary angiography
- Rest regional wall motion was normal, whereas apical hypokinesia developed at peak exercise (asterisk) and had been resolved by the time post-exercise imaging was performed

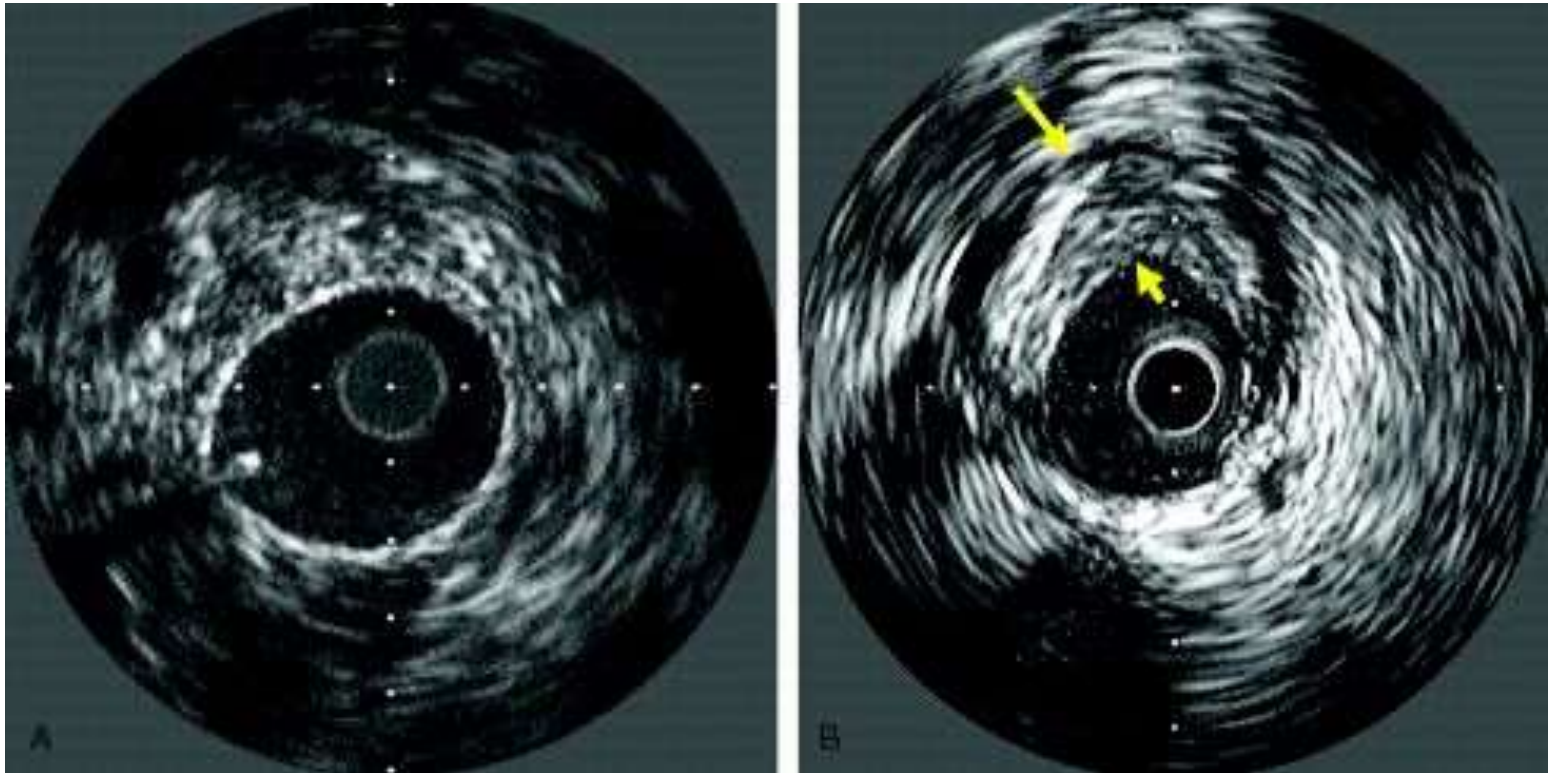


Coronary insufficiency : diagnosis (stress echocardiography)

- Two-chamber apical view of the same patient diastolic (left) and systolic (right) apical frames at rest (top), peak (middle) and post-exercise (bottom) imaging in a patient with a history of previous inferior infarction and showed three-vessel disease on coronary angiography
- Rest regional wall motion was normal, whereas apical hypokinesia developed at peak exercise (asterisk) and had been resolved by the time post-exercise imaging was performed

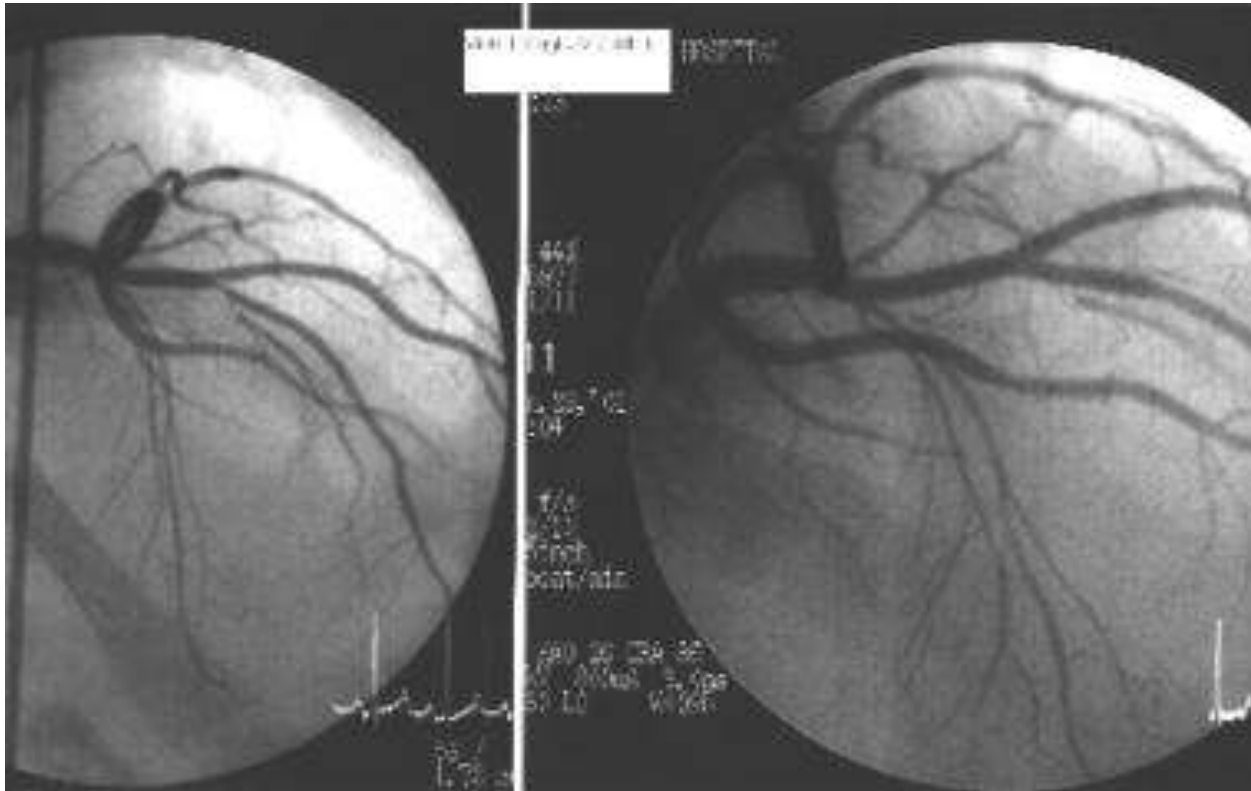


Coronary insufficiency : diagnosis (intravascular echocardiography)



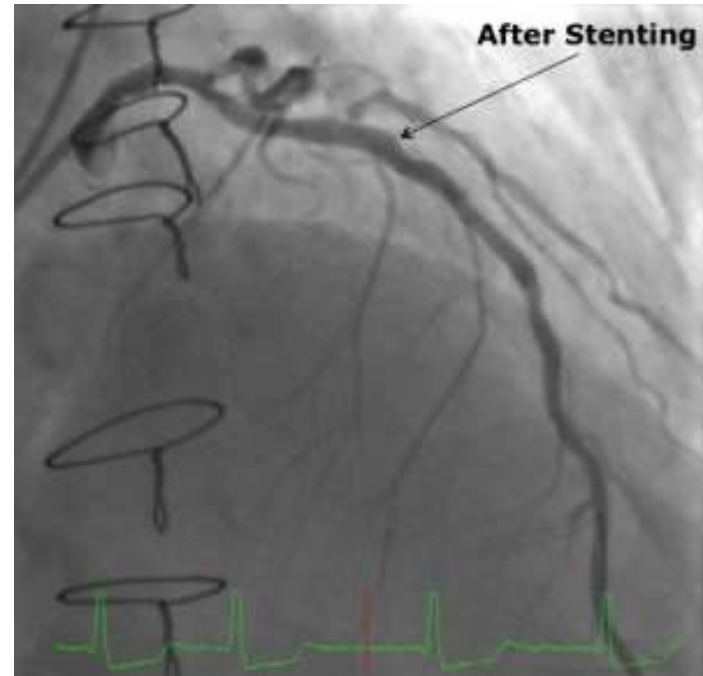
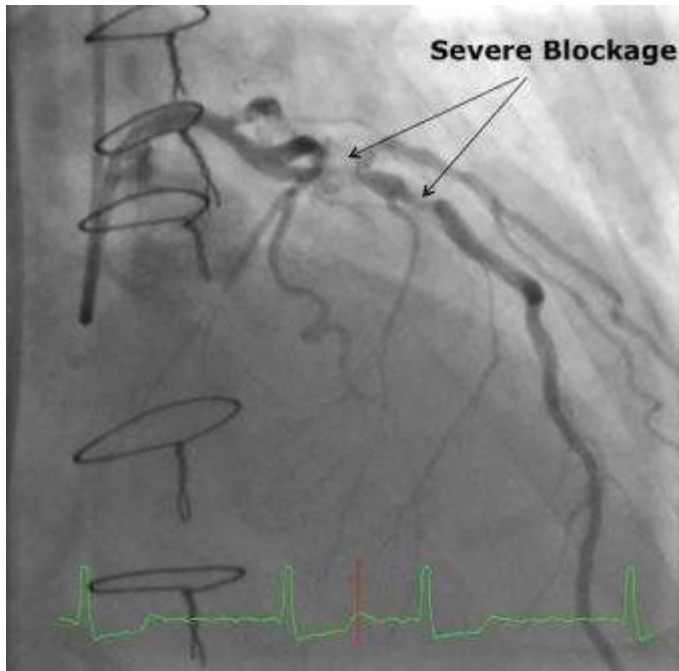
- Left - patient with normal coronaries
- Right - patient with increased coronary intimal thickness (1.2 mm; arrows), suggesting severe vasculopathy

Coronary insufficiency: diagnosis (coronary angiography)



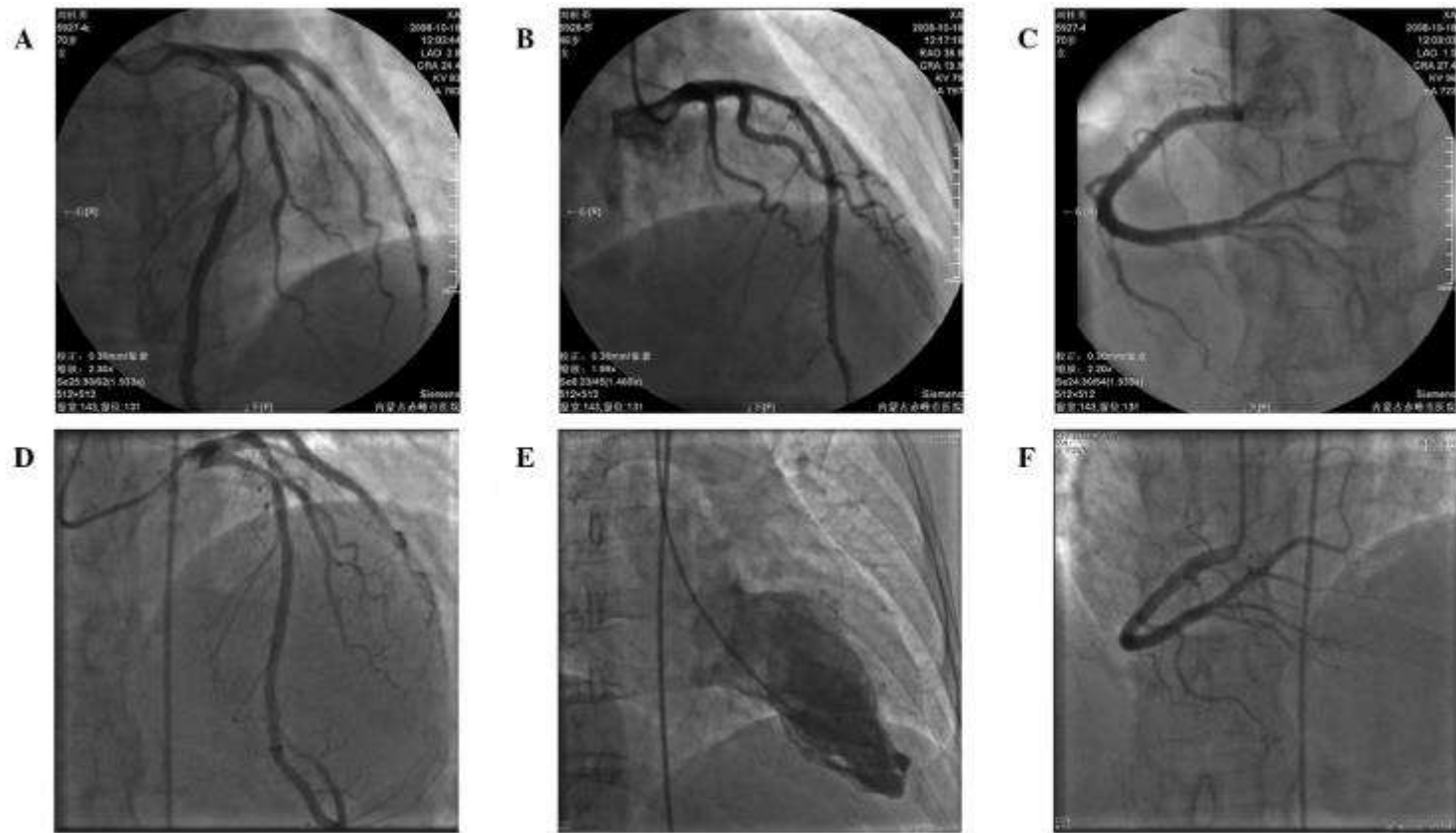
Cardiac catheterization and coronary angiography in the left panel shows severe left anterior descending coronary artery stenosis. This lesion was treated with stent placement in the left anterior descending coronary artery, as observed in the right panel.

Coronary insufficiency : diagnosis (coronary angiography)



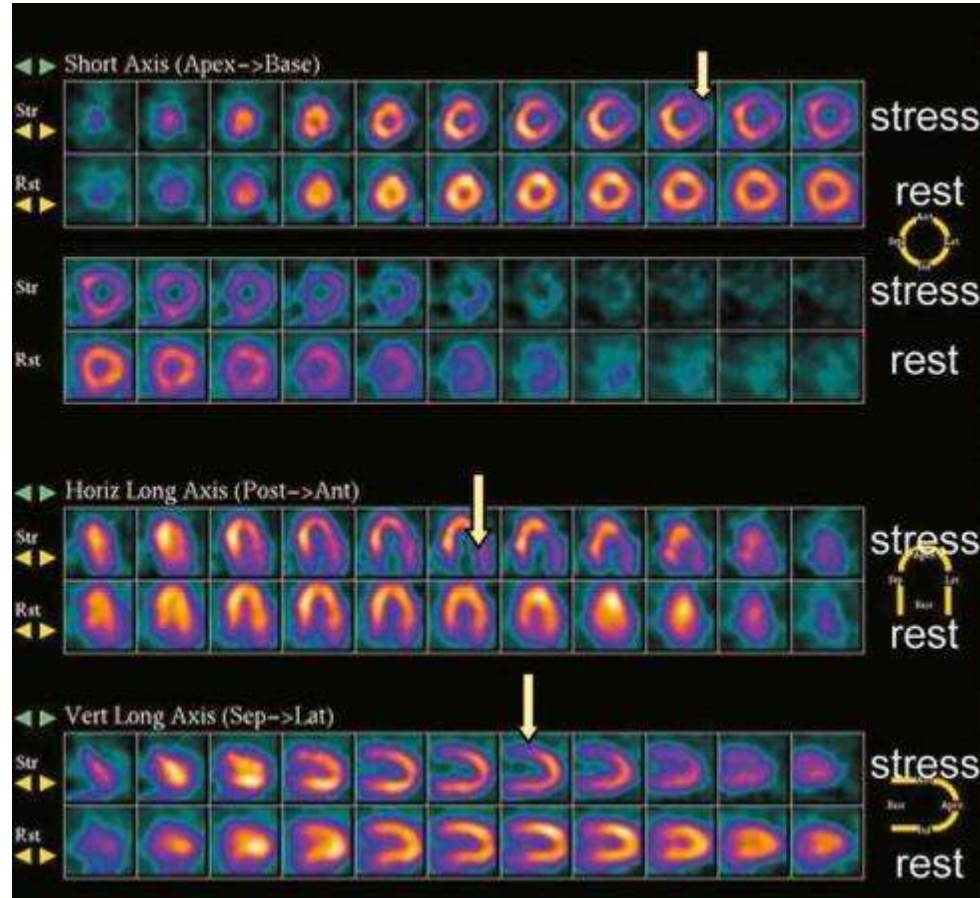
Single-vessel coronary artery disease

Coronary insufficiency : diagnosis (coronary angiography)



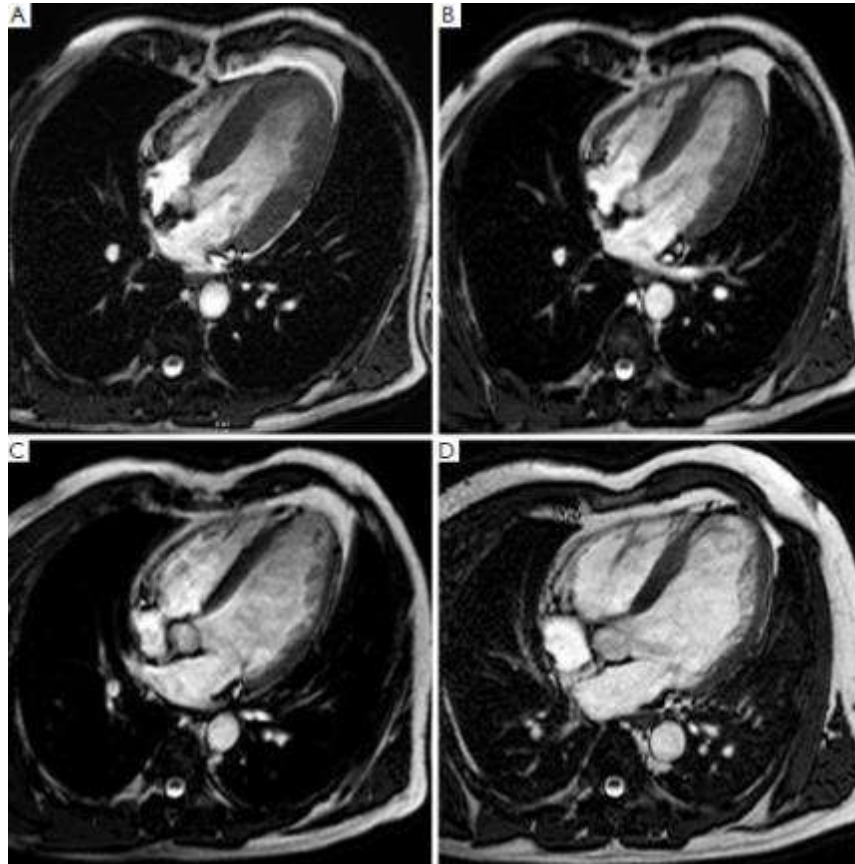
**Coronary angiography of an essential thrombocythemia case with acute myocardial infarction.
Examination results of the (A–C) first and (D–F) second time admissions.**

Coronary insufficiency: diagnosis (radioisotopes)



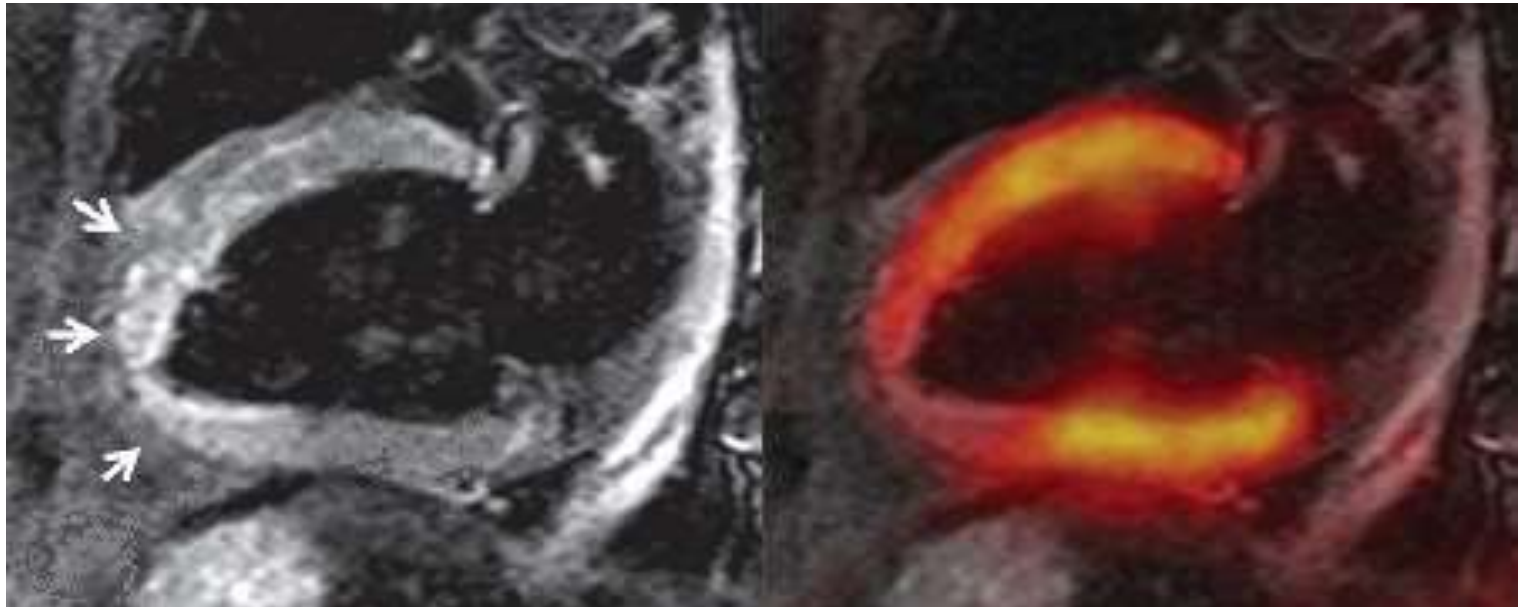
Myocardial perfusion scan. Stress images (arrows) demonstrate inferolateral and anterolateral (left circumflex) ischemia.

Coronary insufficiency : diagnosis (magnetic resonance imaging)



Ventricular remodeling post myocardial infarction.

Coronary insufficiency : diagnosis (positron emission tomography)



The infarct zone of the entire left ventricular myocardium.

Coronary insufficiency : diagnosis (computed tomography)

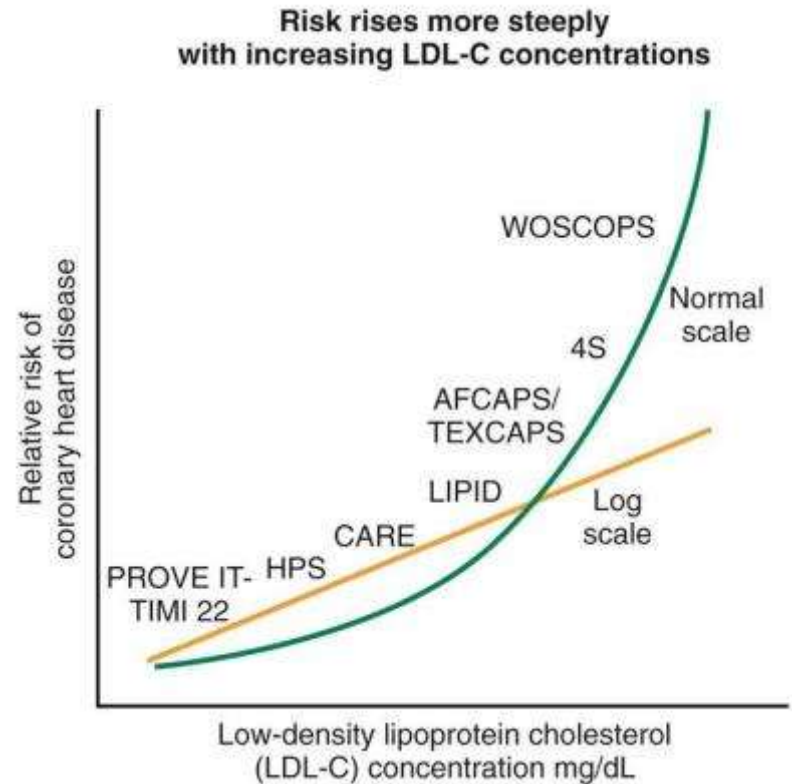
1. Mild proximal stenosis with expansive remodelling and predominantly nonexpansive plaque
2. Partially calcified advanced mid to distal stenosis



Coronary insufficiency : diagnosis (blood test)

Screening for risk of cardiovascular disease may include:

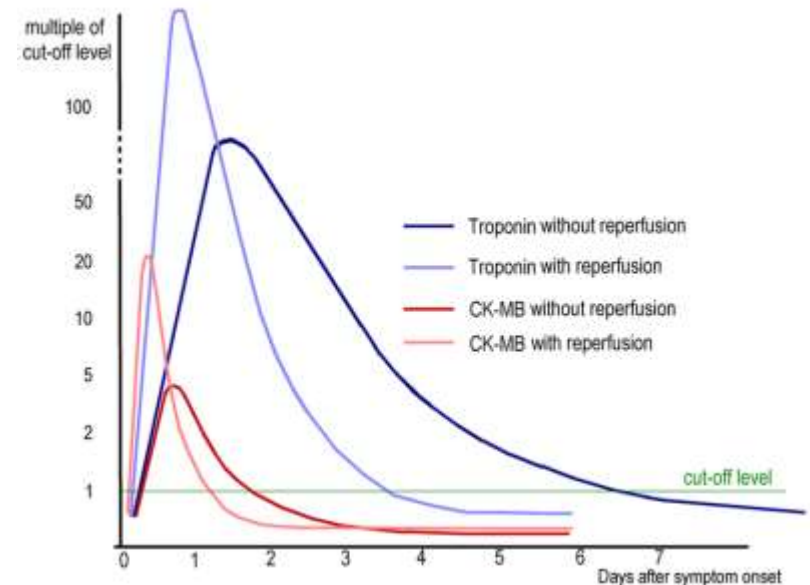
- Lipid profile (LDL-C, HDL-C, cholesterol, triglycerides)—a group of tests that examine the amount and type of lipids (fats) in the blood
- hs-CRP—detects low concentrations of C-reactive protein, a marker of inflammation that is associated with atherosclerosis, among other conditions
- Lp(a)—an additional lipid test that may be used to identify an elevated level of lipoprotein (a), a modification to LDL-C that increases risk of atherosclerosis; the test may be used in conjunction with a routine lipid profile to provide additional information



Coronary insufficiency : diagnosis (blood test)

Heart attacks tests include:

- Troponin—the most commonly ordered and cardiac-specific of the markers; will be elevated within a few hours of heart damage and remain elevated for up to two weeks
- Myoglobin levels
- CK-MB—one particular form of the enzyme creatine kinase that is found mostly in heart muscle and rises when there is damage to the heart muscle cells; this test has largely been replaced with the troponin test



Heart failure

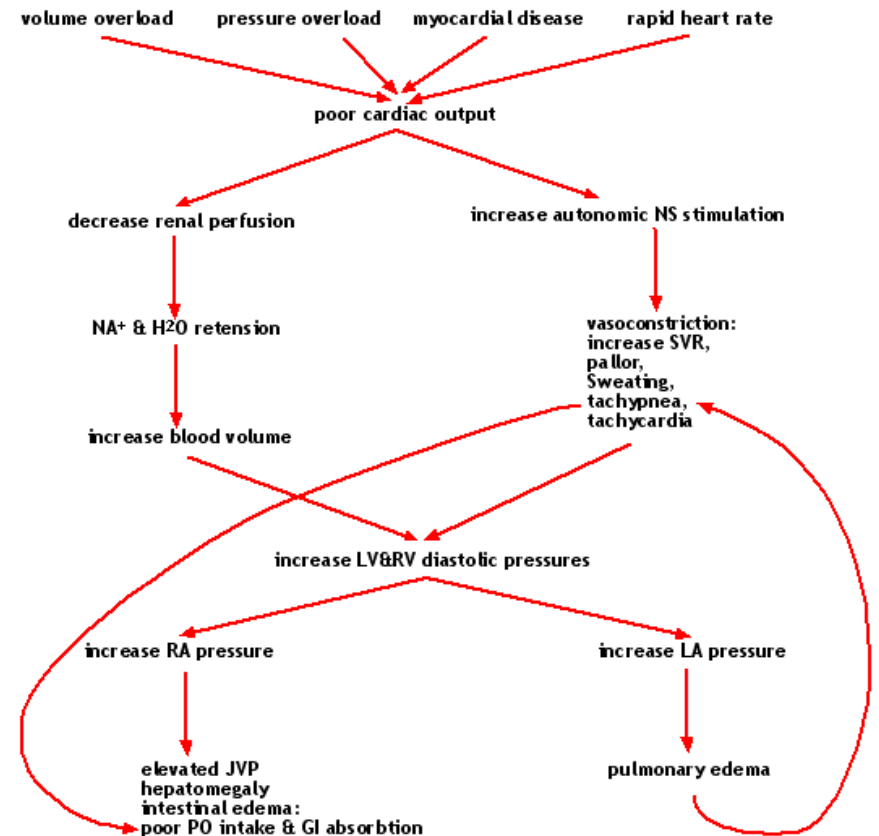
Heart failure: definition

- Heart failure can be defined as an abnormality of cardiac structure or function leading to failure of the heart to deliver oxygen at a rate commensurate with the requirements of the metabolizing tissues, despite normal filling pressures (or only at the expense of increased filling pressures)
- HF is defined, clinically, as a syndrome in which patients have typical symptoms (e.g. breathlessness, ankle swelling, and fatigue) and signs (e.g. elevated jugular venous pressure, pulmonary crackles, and displaced apex beat) resulting from an abnormality of cardiac structure or function

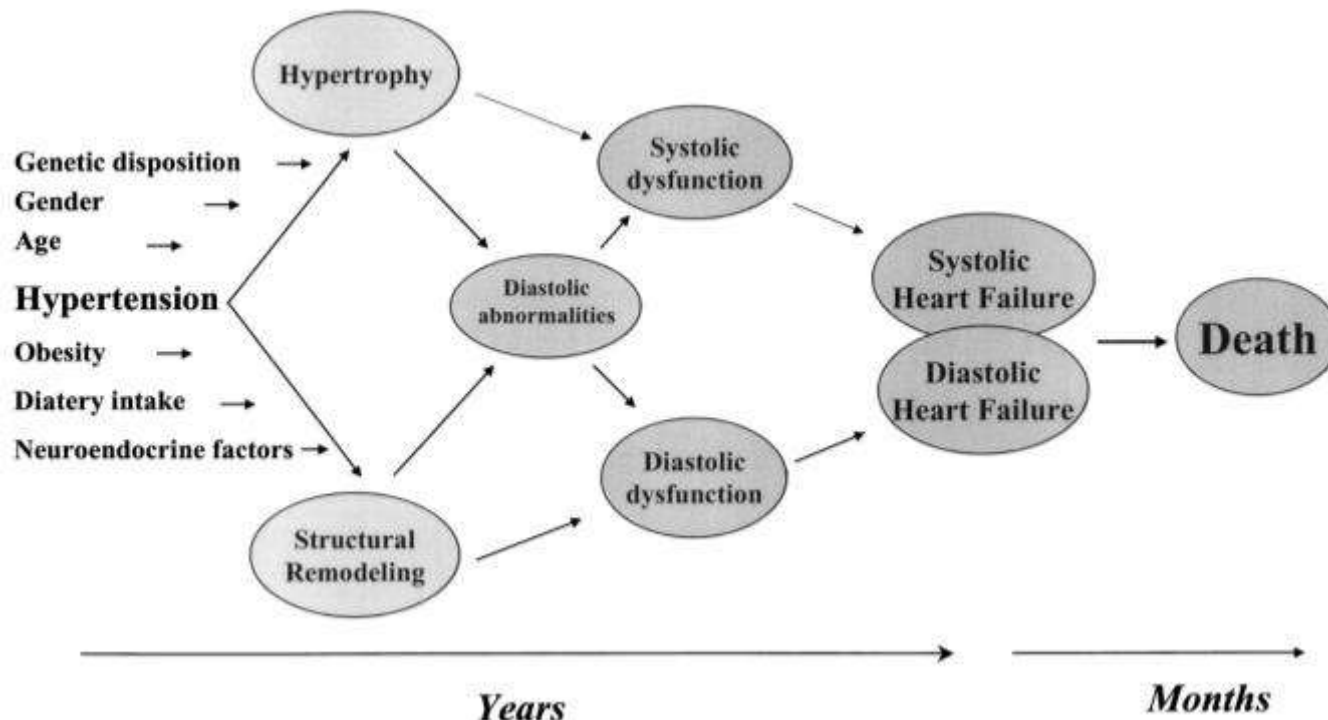


Heart failure: pathophysiology

- In heart failure, the heart may not provide tissues with adequate blood for metabolic needs, and cardiac-related elevation of pulmonary or systemic venous pressures may result in organ congestion
- This condition can result from abnormalities of systolic or diastolic function or, commonly, both
- Although a primary abnormality can be a change in myocyte function, there are also changes in collagen turnover of the extracellular matrix



Heart failure: pathophysiology

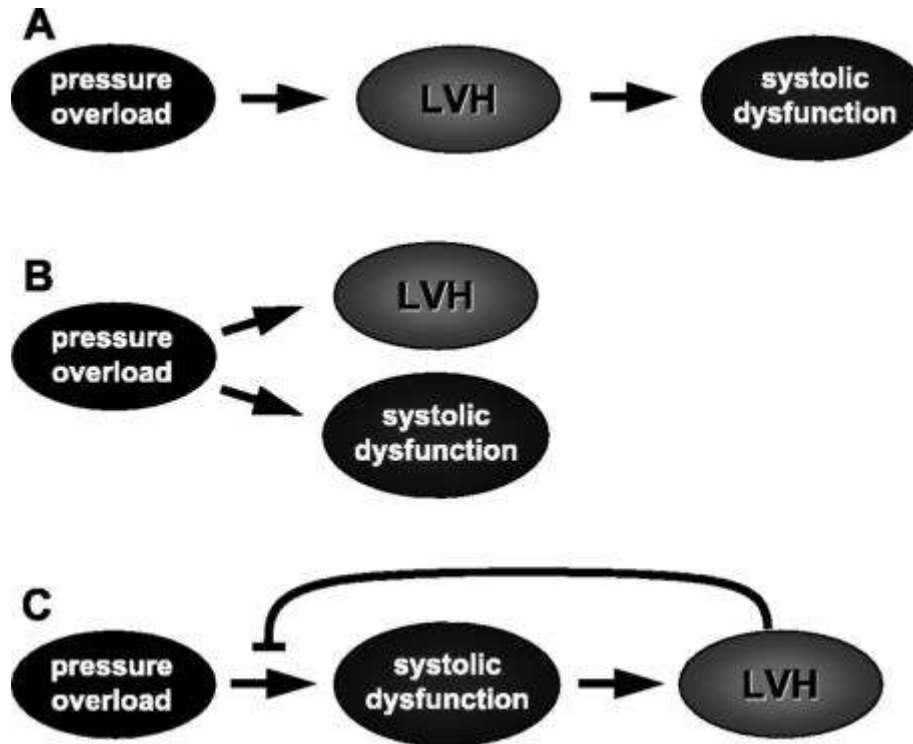


Progression from hypertrophy to diastolic heart failure. Several cardiovascular risk factors are associated with the occurrence of LV hypertrophy and structural remodeling. At the initial stage diastolic abnormalities are present with maintained systolic and diastolic function. During follow-up, systolic and diastolic dysfunction occur and are associated either systolic pump or diastolic filling failure. In the presence of congestive symptoms the time course of heart failure may become progressive and may end with sudden cardiac death or intractable end-stage failure.

Heart failure: systolic dysfunction

- In systolic dysfunction (heart failure (HF) with reduced ejection fraction (EF)), the ventricle contracts poorly and empties inadequately, leading initially to increased diastolic volume and pressure and decreased EF
- Many defects in energy utilization, energy supply, electrophysiologic functions, and contractile element interaction occur, with abnormalities in intracellular Ca modulation and cAMP production
- Predominant systolic dysfunction is common in HF due to MI, myocarditis, and dilated cardiomyopathy
- Systolic dysfunction may affect primarily the left ventricle (LV) or the right ventricle (RV)
- LV failure often leads to RV failure

Heart failure: systolic dysfunction

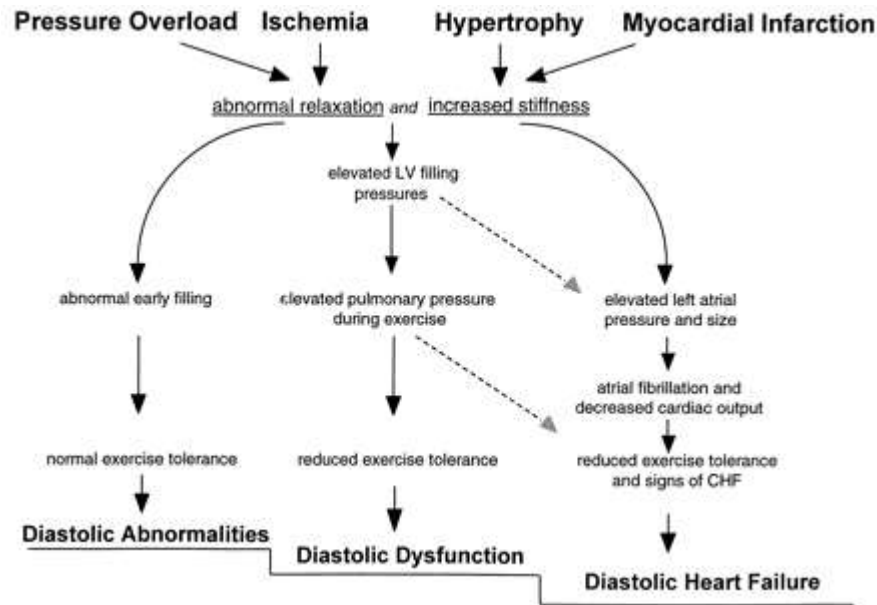


Left ventricular hypertrophy (LVH) and systolic dysfunction. **A:** LVH is a mechanistic step in the pathogenesis of load-induced systolic dysfunction. **B:** development of LVH occurs in parallel with systolic dysfunction. **C:** LVH is a compensatory response to stress-mediated systolic dysfunction.

Heart failure: diastolic dysfunction

- In diastolic dysfunction (heart failure (HF) with preserved ejection fraction (EF), ventricular filling is impaired, resulting in reduced ventricular end-diastolic volume, increased end-diastolic pressure, or both
- Contractility and hence EF remain normal
- EF may even increase as the poorly filled LV empties more completely to maintain cardiac output (CO)
- Markedly reduced LV filling can cause low CO and systemic symptoms
Elevated left atrial pressures can cause pulmonary hypertension and pulmonary congestion
- Diastolic dysfunction usually results from impaired ventricular relaxation (an active process), increased ventricular stiffness due to valvular disease, constrictive pericarditis, acute myocardial ischemia, hypertrophic cardiomyopathy, disorders with ventricular hypertrophy (e.g., hypertension, significant aortic stenosis), and amyloid infiltration of the myocardium.
- Resistance to filling increases with age, probably reflecting myocyte loss

Heart failure: diastolic dysfunction



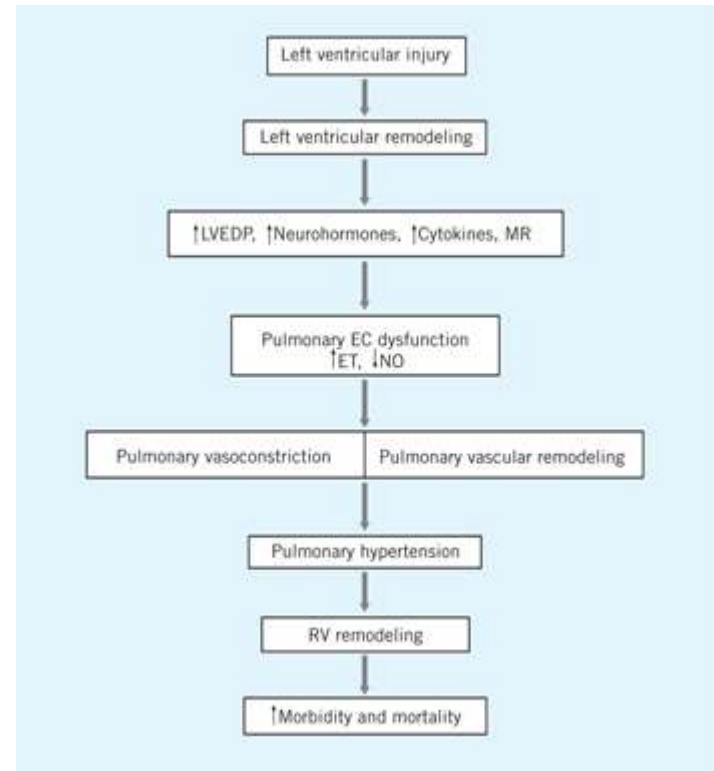
Pathophysiology of diastolic heart failure. Abnormal relaxation and increased stiffness are associated with diastolic filling abnormalities and normal exercise tolerance in the early phase of diastolic dysfunction. When the disease progresses, pulmonary pressures increase abnormally during exercise with reduced exercise tolerance. When filling pressures increases further, left atrial pressure and size increase and exercise tolerance falls with clinical signs of congestive heart failure (CHF).

Heart failure: left ventricle failure

- Cardiac output (CO) decreases and pulmonary venous pressure increases
- When pulmonary capillary pressure exceeds the oncotic pressure of plasma proteins (about 24 mm Hg), fluid extravasates from the capillaries into the interstitial space and alveoli, reducing pulmonary compliance and increasing the work of breathing
- Lymphatic drainage increases but cannot compensate for the increase in pulmonary fluid
- Marked fluid accumulation in alveoli (pulmonary edema) significantly alters ventilation/perfusion relationships
- In severe or chronic LV failure, pleural effusions characteristically develop in the right hemithorax and later bilaterally, further aggravating dyspnea

Heart failure: left ventricle failure

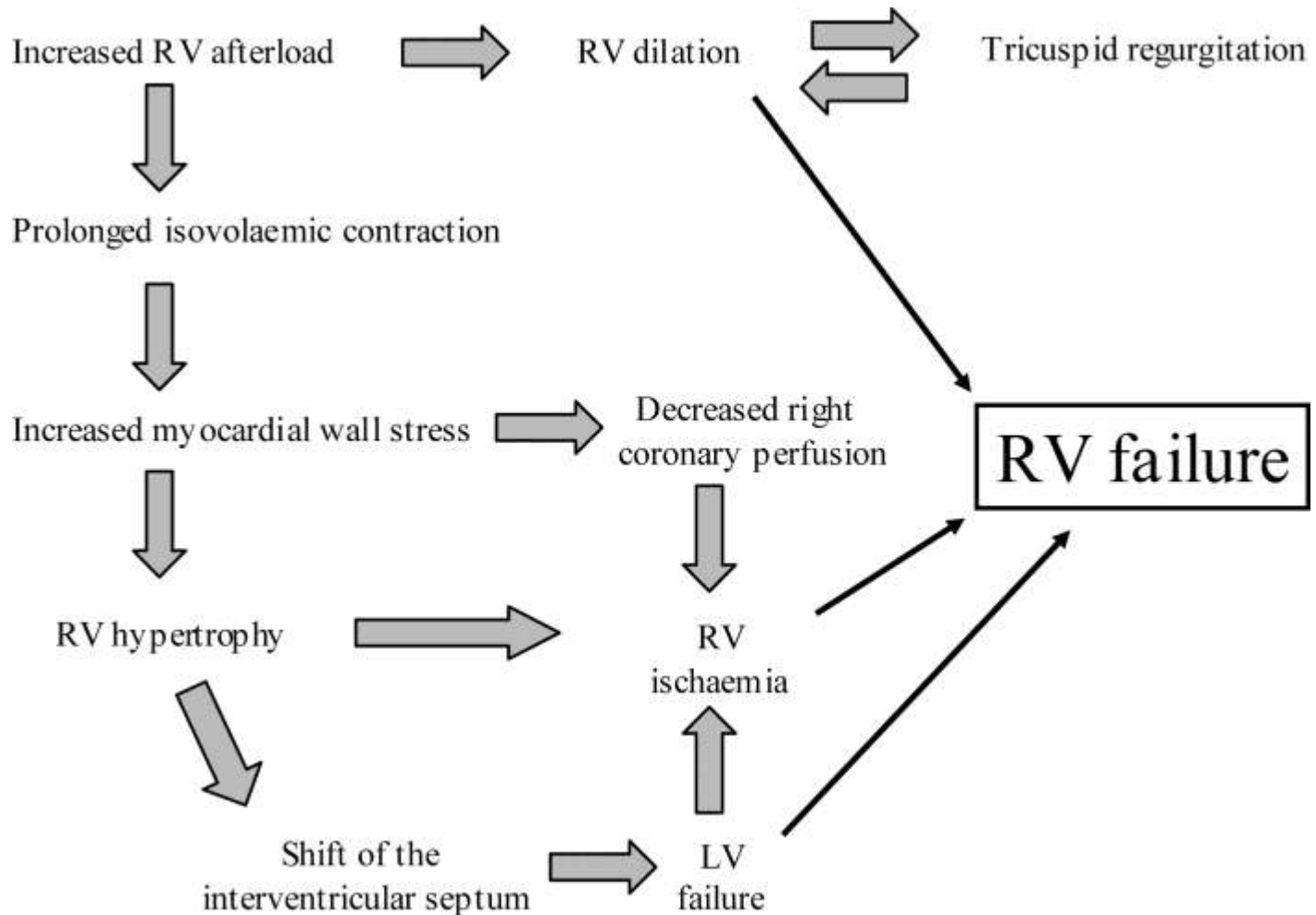
Left ventricular injury leading to structural remodeling and dysfunction is the seminal event in the progression of heart failure



Heart failure: right ventricle failure

- Systemic venous pressure increases, causing fluid extravasation and consequent edema, primarily in dependent tissues (feet and ankles of ambulatory patients) and abdominal viscera
- The liver is most severely affected, but the stomach and intestine also become congested
- Fluid accumulation in the peritoneal cavity (ascites) can occur
- Right ventricle failure commonly causes moderate hepatic dysfunction, with usually modest increases in conjugated and unconjugated bilirubin, hepatic enzymes, etc.
- The impaired liver breaks down less aldosterone, further contributing to fluid accumulation
- Chronic venous congestion in the viscera can cause anorexia, malabsorption of nutrients and drugs, protein-losing enteropathy (characterized by diarrhea and marked hypoalbuminemia), chronic GI blood loss, and rarely ischemic bowel infarction

Heart failure: right ventricle failure

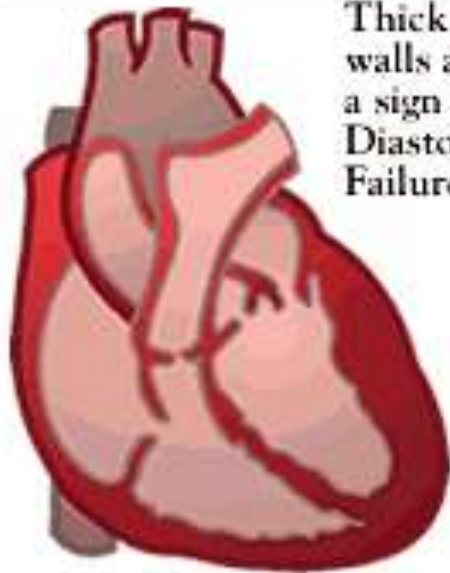


Heart failure: cardiac response

- If ventricular function is impaired, a higher preload is required to maintain cardiac output (CO)
- The ventricles are remodeled over time: the left ventricle (LV) becomes less ovoid and more spherical, dilates, and hypertrophies; the right ventricle (RV) dilates and may hypertrophy.
- Initially compensatory, these changes eventually increase diastolic stiffness and wall tension (i.e., diastolic dysfunction develops), compromising cardiac performance, especially during physical stress
- Increased wall stress raises O_2 demand and accelerates apoptosis (programmed cell death) of myocardial cells
- Dilation of the ventricles can also cause mitral or tricuspid valve regurgitation with further increases in end-diastolic volumes

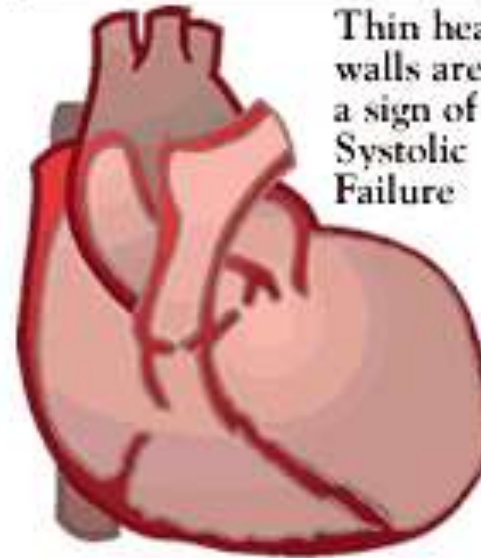
Heart failure: cardiac response

Diastolic Failure



Thick heart
walls are
a sign of
Diastolic
Failure

Systolic Failure

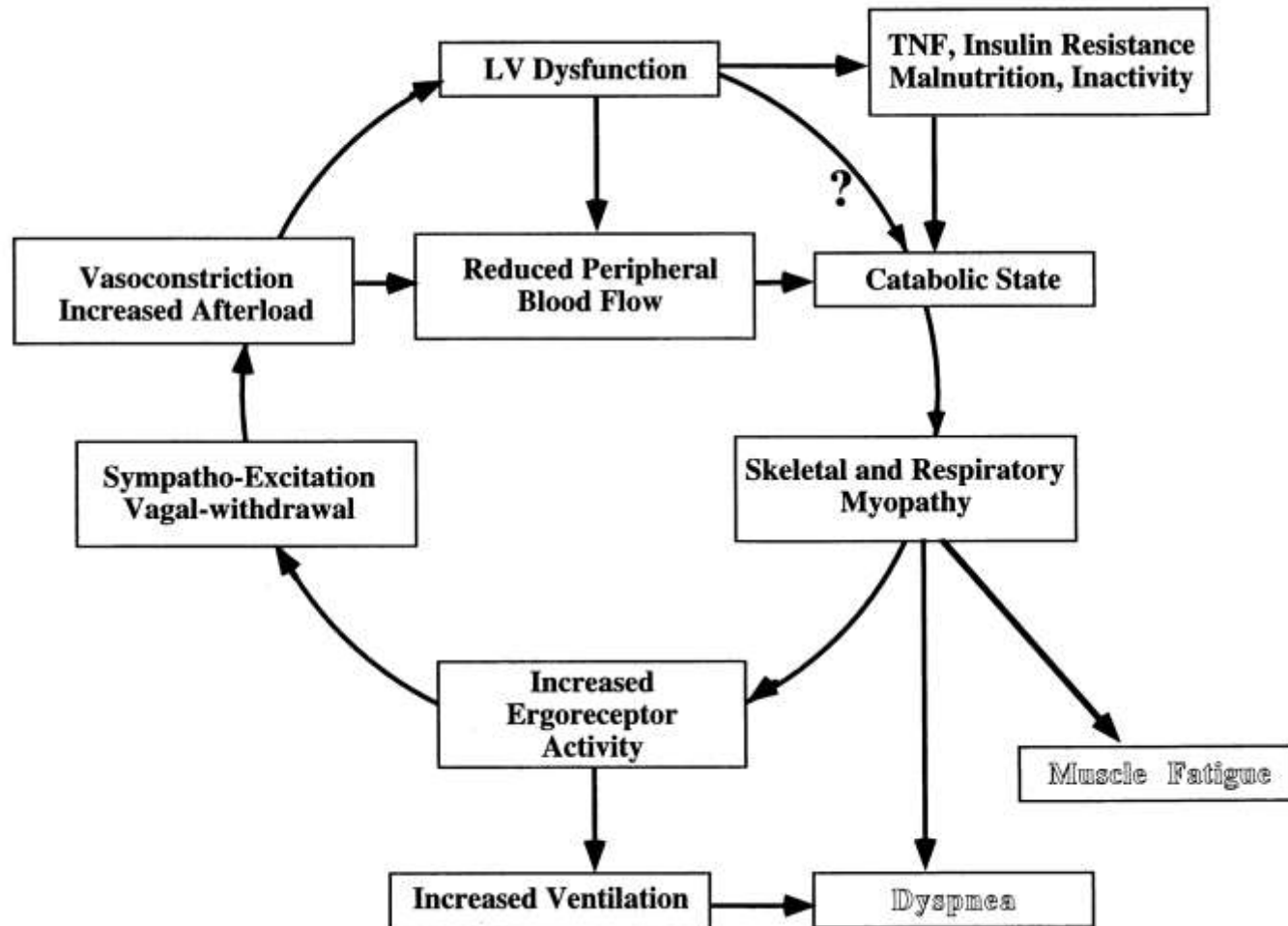


Thin heart
walls are
a sign of
Systolic
Failure

Heart failure: hemodynamic responses

- With reduced cardiac output (CO), O₂ delivery to the tissues is maintained by increasing O₂ extraction and sometimes shifting the oxyhemoglobin dissociation curve to the right to favor O₂ release
- Reduced CO with lower systemic blood pressure (BP) activates arterial baroreflexes, increasing sympathetic tone and decreasing parasympathetic tone
- Heart rate and myocardial contractility increase, arterioles in selected vascular beds constrict, venoconstriction occurs, and Na and water are retained
- These changes compensate for reduced ventricular performance and help maintain hemodynamic homeostasis in the early stages of heart failure (HF)
- These compensatory changes increase cardiac work, preload, and afterload; reduce coronary and renal perfusion; cause fluid accumulation resulting in congestion; increase K excretion; and may cause myocyte necrosis and arrhythmias

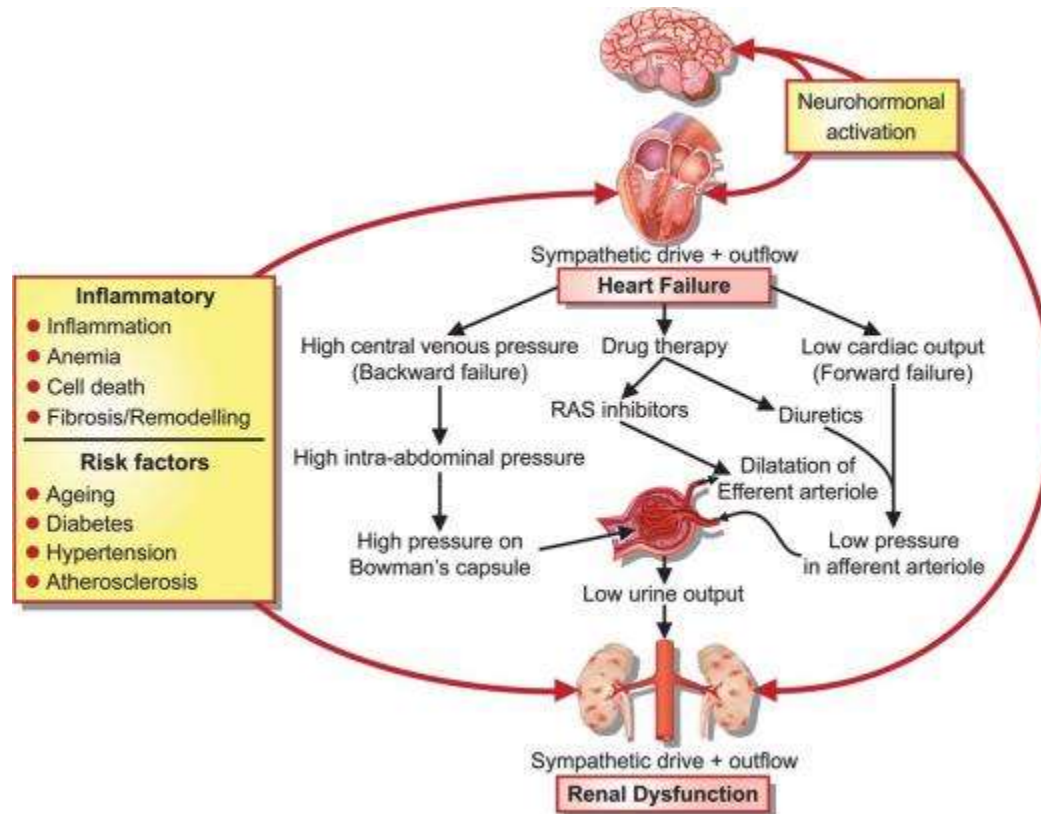
Heart failure: hemodynamic responses



Heart failure: renal responses

- As cardiac function deteriorates, renal blood flow and Glomerular Filtration Rate (GFR) decrease, and blood flow within the kidneys is redistributed
- The filtration fraction and filtered Na decrease, but tubular resorption increases, leading to Na and water retention
- Blood flow is further redistributed away from the kidneys during exercise, but renal blood flow improves during rest, possibly contributing to nocturia
- Decreased perfusion of the kidneys (and possibly decreased arterial systolic stretch secondary to declining ventricular function) activates the renin-angiotensin-aldosterone system, increasing Na and water retention and renal and peripheral vascular tone; these effects are amplified by the intense sympathetic activation accompanying heart failure (HF)
- These processes causes a cascade of potentially deleterious long-term effects with myocardial and vascular collagen deposition and fibrosis, vascular and myocardial hypertrophy, thus contributing to the remodeling of the heart and peripheral vasculature, potentially worsening HF

Heart failure: renal responses



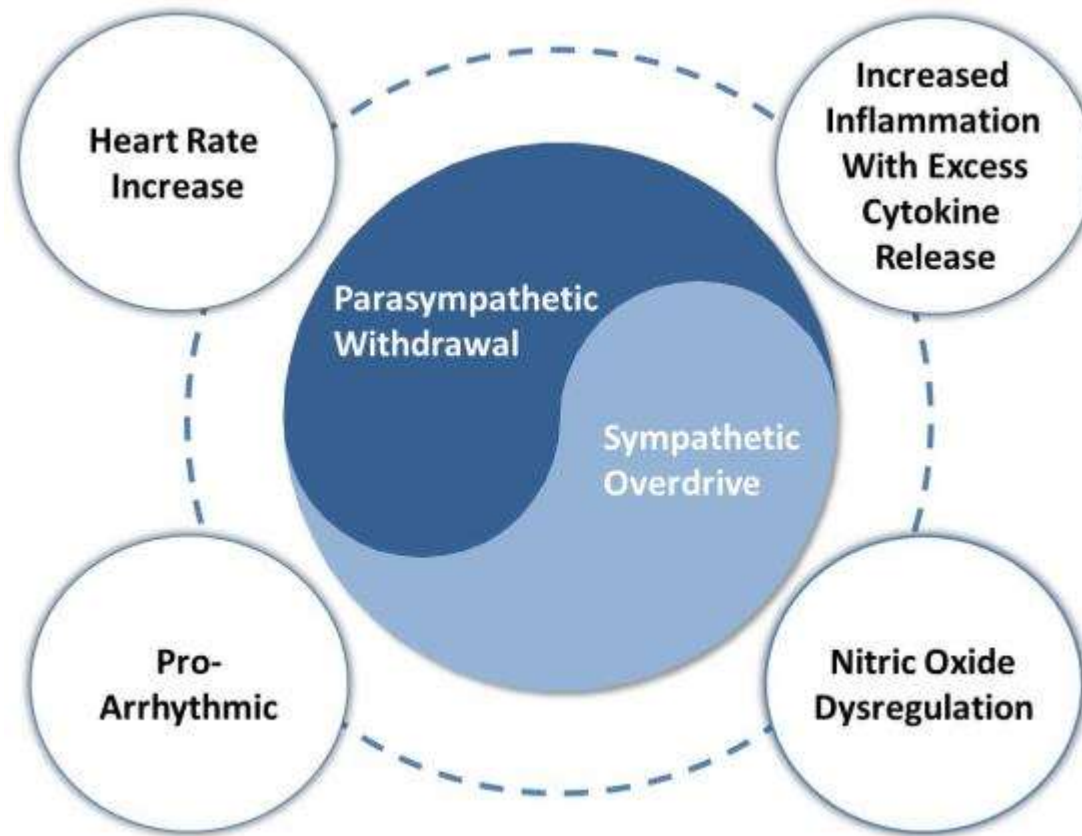
Potential pathogenetic pathways linking heart failure with renal dysfunction. RAS, renin–angiotensin system.

Heart failure:

neurohumoral responses

- Chronic activation of neurohumoral responses is detrimental to the normal balance between myocardial-stimulating and vasoconstricting hormones and between myocardial-relaxing and vasodilating hormones :
 - β_1 receptors are downregulated , probably in response to intense sympathetic activation
 - Plasma norepinephrine levels are increased, largely reflecting sympathetic nerve stimulation as plasmaepinephrine levels are not increased
 - Vasopressin is released in response to a fall in blood pressure (BP)
 - Atrial natriuretic peptide is released in response to increased atrial volume and pressure
 - Brain (B-type) natriuretic peptide (BNP) is released from the ventricle in response to ventricular stretching
 - Fewer endogenous vasodilators are produced, and more endogenous vasoconstrictors are produced, thus increasing afterload
 - The failing heart and other organs produce tumor necrosis factor (TNF)- α

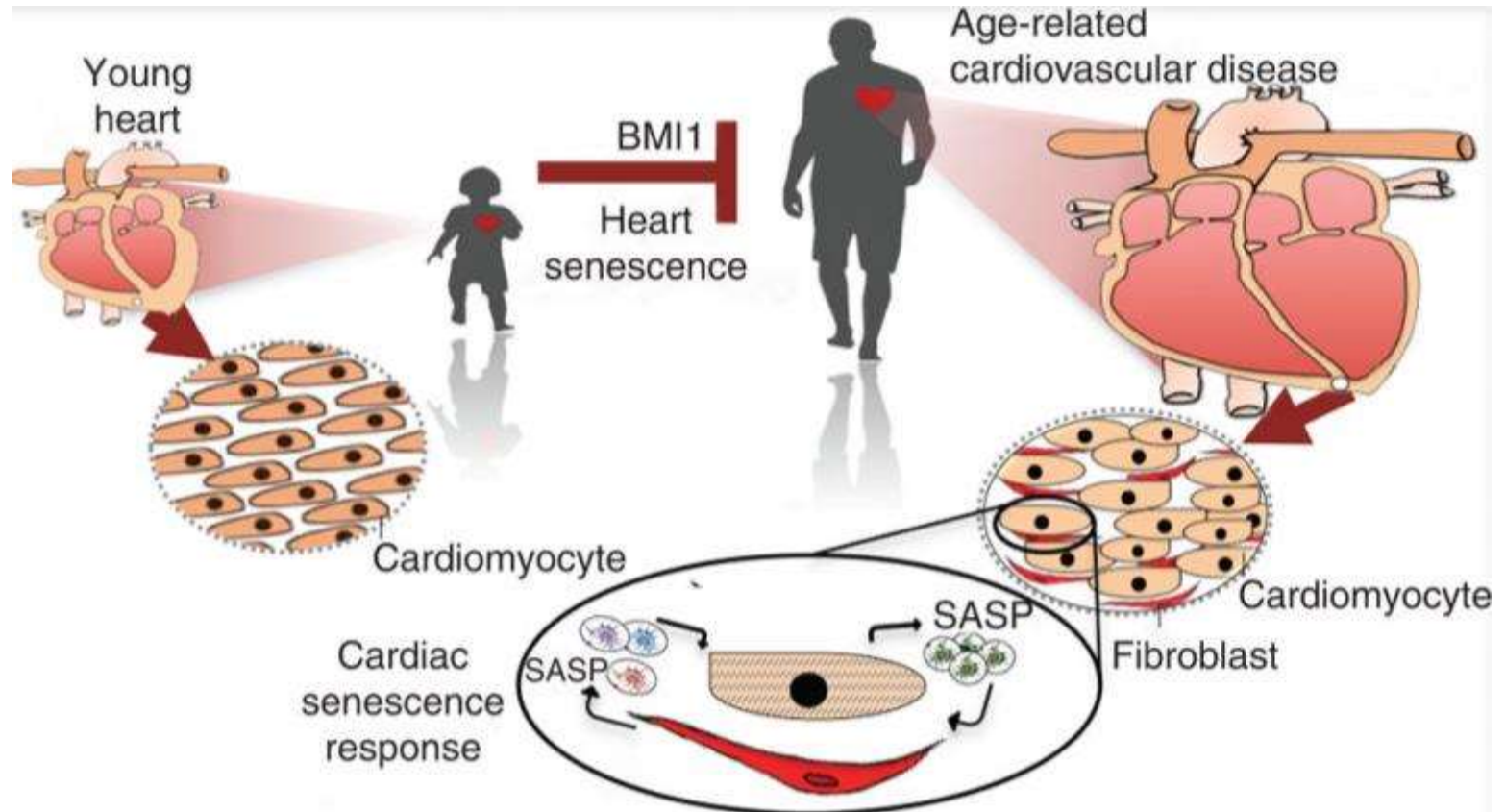
Heart failure: neurohumoral responses



Heart failure: changes with aging

- Age-related changes in the heart and cardiovascular system lower the threshold for expression of heart failure (HF0
- Interstitial collagen within the myocardium increases, the myocardium stiffens, and myocardial relaxation is prolonged
- These changes lead to a significant reduction in diastolic LV function, even in healthy elderly people
- Modest decline in systolic function also occurs with aging
- An age-related decrease in myocardial and vascular responsiveness to β -adrenergic stimulation further impairs the ability of the cardiovascular system to respond to increased work demands

Heart failure: changes with aging

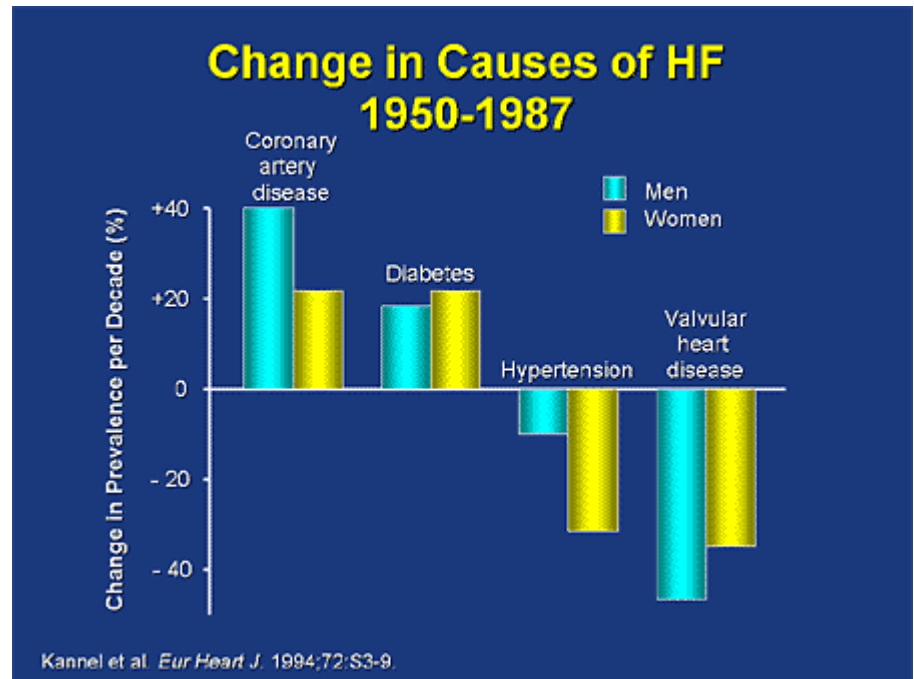


As aging poses the largest risk for cardiovascular disease, the cardiac Bmi1 action could be determinant to limit the heart senescence response. Our data establish the idea that the nonproliferative cardiomyocyte-related senescence phenotype can be locally propagated through the SASP (senescence-associated secretory phenotype)

Heart failure: causes

Heart failure can complicate any cardiovascular disease sooner or later

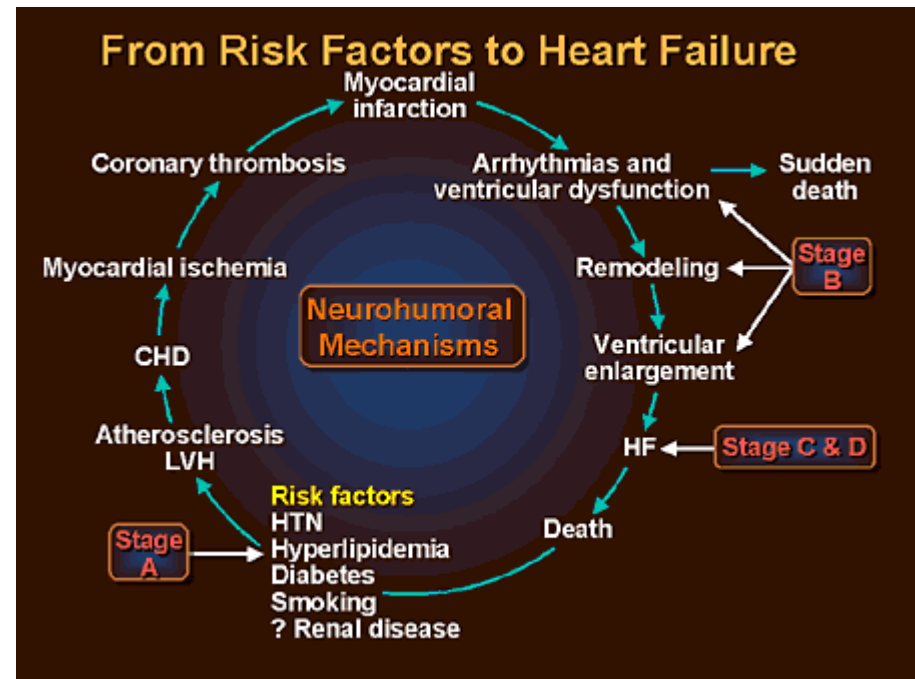
- Coronary artery disease
- High blood pressure
- Atrial fibrillation
- Valvular heart disease
- Excess alcohol use
- Infection
- Cardiomyopathy
- Thyroid disease
- Kidney disease
- Diabetes
- Heart defects present at birth



Heart failure: risk factors

Risk factors for cardiovascular diseases = risk factors for heart failure

- High blood pressure
- Coronary artery disease
- Heart attack
- Diabetes
- Some diabetes medications
- Sleep apnea
- Congenital heart defects
- Valvular heart disease
- Viruses
- Alcohol use
- Tobacco use
- Obesity
- Irregular heartbeats



Heart failure: classification

- Acute or chronic (congestive)
- High output or low output
- Systolic or diastolic
- Left heart or right heart or biventricular
- Dilated or nondilated
- Cause: ischemic, hypertensive, idiopathic dilated cardiomyopathy, etc.



Heart failure: signs and symptoms

- Shortness of breath (dyspnea)
- Fatigue and weakness
- Swelling (edema) in legs, ankles and feet
- Rapid or irregular heartbeat
- Reduced ability to exercise
- Persistent cough or wheezing with white or pink blood-tinged phlegm
- Increased need to urinate at night
- Swelling of abdomen (ascites)
- Sudden weight gain from fluid retention
- Lack of appetite and nausea
- Difficulty concentrating or decreased alertness
- Sudden, severe shortness of breath and coughing up pink, foamy mucus
- Chest pain if heart failure is caused by a heart attack

Heart failure:

signs and symptoms of left heart failure

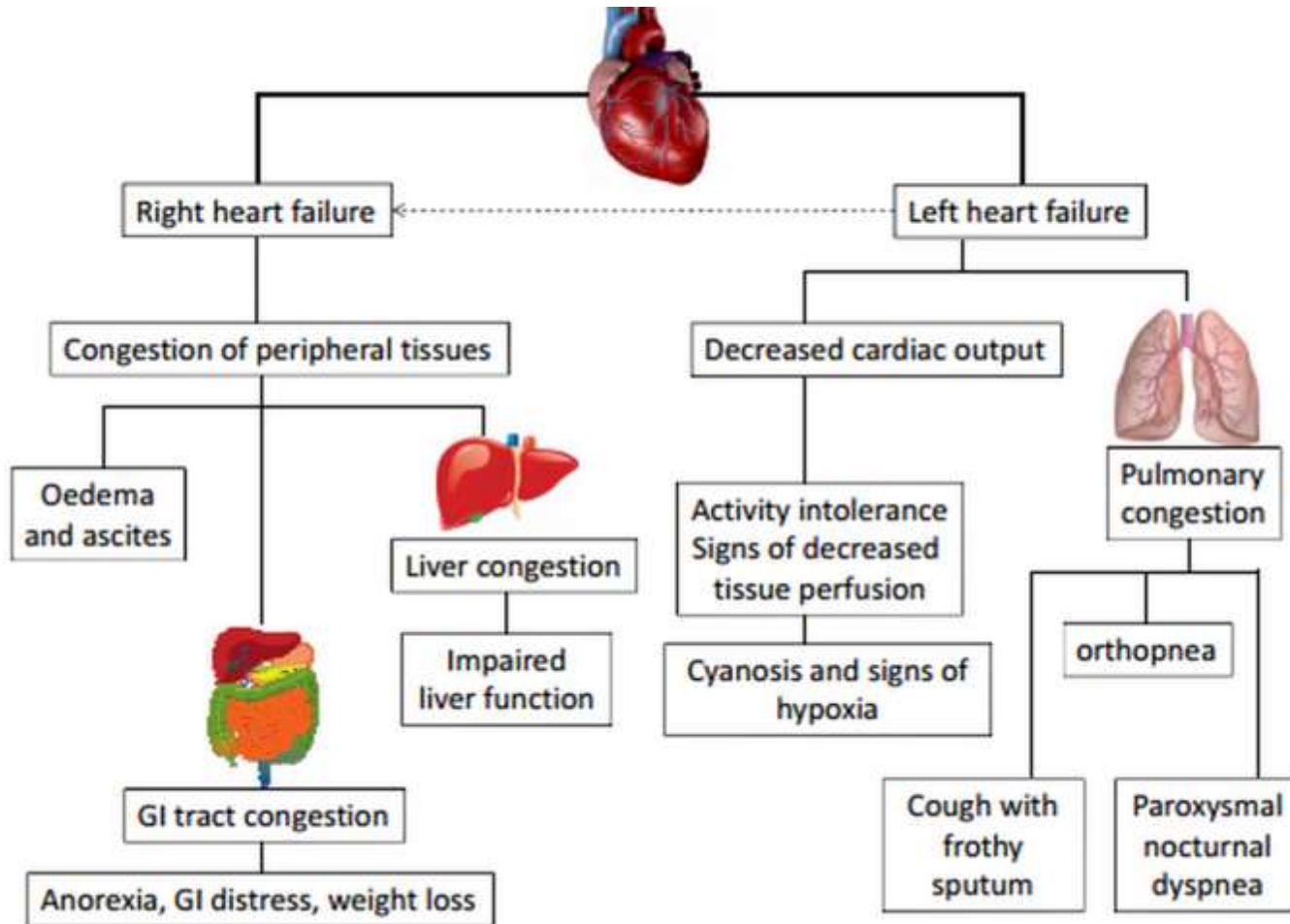
- The most common symptoms are dyspnea, reflecting pulmonary congestion, and fatigue, reflecting low cardiac output (CO)
- Dyspnea occurs during exertion and is relieved by rest, and as heart failure (HF) worsens, it can occur during rest and at night, sometimes causing nocturnal cough
- In paroxysmal nocturnal dyspnea (PND), dyspnea awakens patients several hours after they lie down and is relieved only after they sit up for 15 to 20 min
- In severe HF, periodic cycling of breathing (Cheyne-Stokes) can occur during the day or night
- Sleep-related breathing disorders, such as sleep apnea, are common in HF and may aggravate HF
- Severely reduced cerebral blood flow and hypoxemia can cause chronic irritability and impair mental performance

Heart failure:

signs and symptoms of right heart failure

- The most common symptoms are ankle swelling and fatigue
- Hepatic congestion can cause right upper quadrant abdominal discomfort, and stomach and intestinal congestion can cause anorexia and abdominal bloating
- Less specific symptoms include cool peripheries, postural light-headedness, nocturia, and decreased daytime micturition
- Skeletal muscle wasting can occur in severe biventricular failure and may reflect some disuse but also increased catabolism associated with increased cytokine production
- Significant weight loss (cardiac cachexia) is an ominous sign associated with high mortality
- In the elderly, presenting complaints may be atypical, such as confusion, delirium, falls, sudden functional decline, nocturnal urinary incontinence, or sleep disturbance
- Coexisting cognitive impairment and depression

Heart failure: signs and symptoms

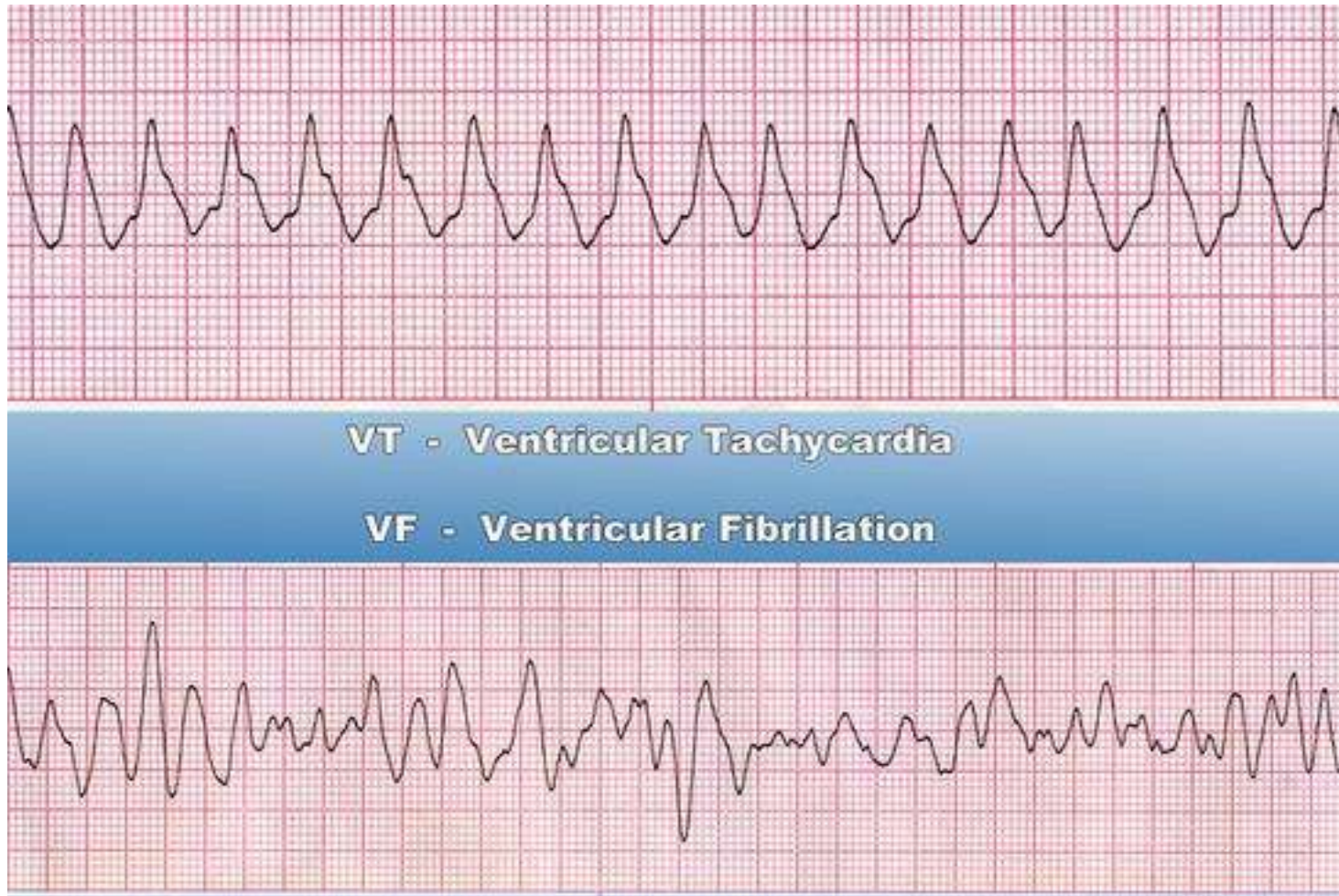


Heart failure:

examination in left heart failure

- In left heart (left ventricle - LV) failure, tachycardia and tachypnea, hypotension, and confusion because of hypoxia and poor cerebral perfusion may occur
- Central cyanosis reflects severe hypoxemia; peripheral cyanosis of the lips, fingers, and toes reflects low blood flow with increased O_2 extraction
- LV systolic dysfunction include a diffuse, sustained, and laterally displaced apical impulse; audible and occasionally palpable 3rd (S_3) and 4th (S_4) heart sounds, and an accentuated pulmonic component (P_2) of the 2nd heart sound (S_2); a pansystolic murmur of mitral regurgitation at the apex may occur
- Pulmonary findings include early inspiratory basilar crackles that do not clear with coughing and, if pleural effusion is present, dullness to percussion and diminished breath sounds at the lung base(s)

Heart failure: examination in left heart failure (tachycardia)



Heart failure: examination in left heart failure (central cyanosis)

Central cyanosis is caused by abnormal composition of hemoglobin such as sulphaemoglobinaemia and methaemoglobinaemia or decreased in the saturation of the oxygen because of cyanotic congenital heart disease, pulmonary embolism, pulmonary edema (required urgent treatment) and severe respiratory disease

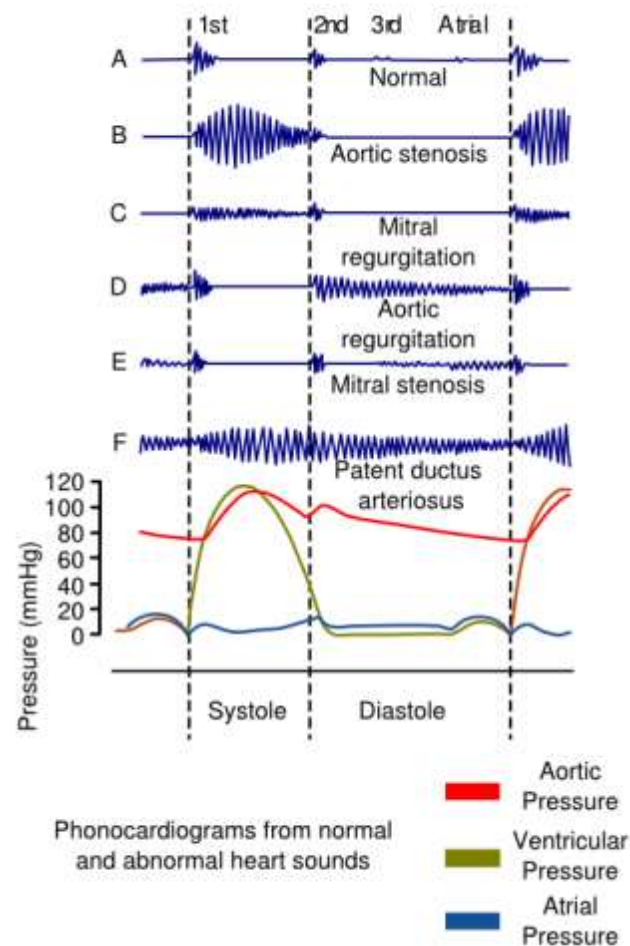
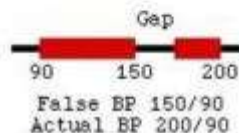
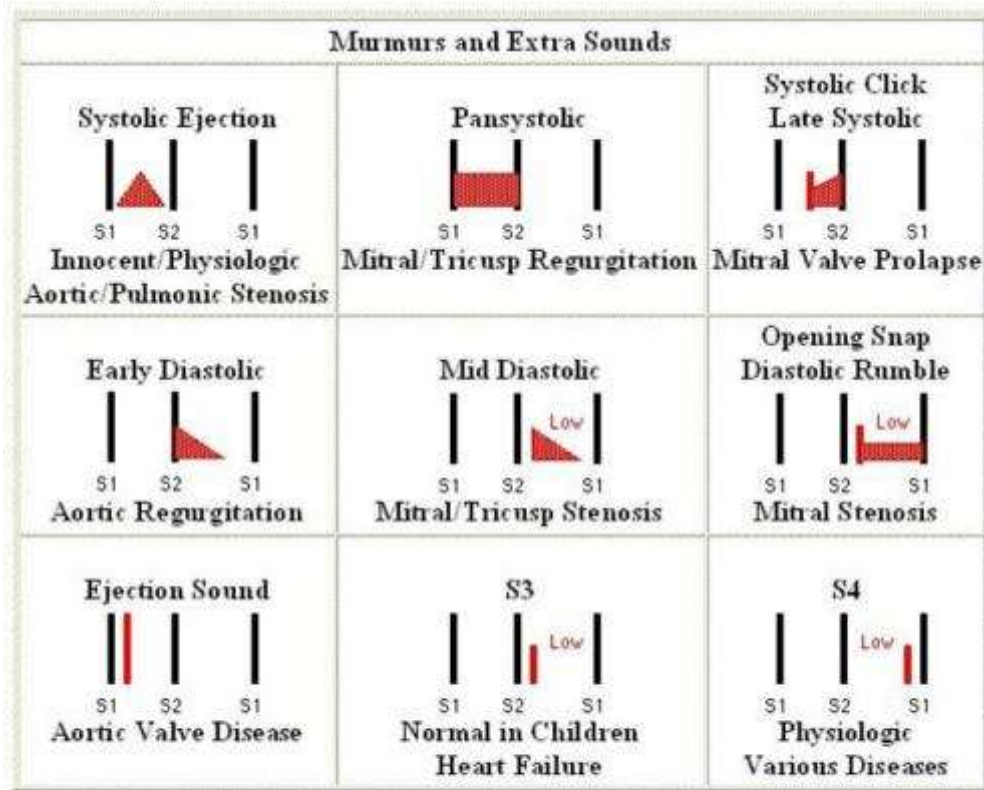


Heart failure: examination in left heart failure (peripheral cyanosis)

- Peripheral cyanosis can be a result of the causes of central cyanosis or can occur in isolation
- Common causes of peripheral cyanosis without central cyanosis are:
 - Peripheral vasoconstriction due to cold, Raynaud's phenomenon or beta blocker drugs
 - Reduced cardiac output due to cardiac failure or hypovolemia
 - Peripheral vascular disease
 - Venous obstruction, such as a deep vein thrombosis or obstruction of the superior vena cava



Heart failure: examination in left heart failure (heart sounds)



Heart failure:

examination in right heart failure

- Nontender peripheral pitting edema (digital pressure leaves visible and palpable imprints, sometimes quite deep) in the feet and ankles; an enlarged and sometimes pulsatile liver palpable below the right costal margin; abdominal swelling and ascites; and visible elevation of the jugular venous pressure, sometimes with large *a* or *v* waves that are visible even when the patient is seated or standing
- In severe cases, peripheral edema can extend to the thighs or even the sacrum, scrotum, lower abdominal wall, and occasionally even higher (anasarca); edema may be asymmetric if patients lie predominantly on one side
- With hepatic congestion, the liver may be palpably enlarged or tender, and hepato jugular or abdominal-jugular reflux may be detected
- Precordial palpation may detect the left parasternal lift of RV enlargement, and auscultation may detect the murmur of tricuspid regurgitation or the RV S_3 along the left sternal border; both findings are augmented upon inspiration

Heart failure: examination in right heart failure (peripheral edema)

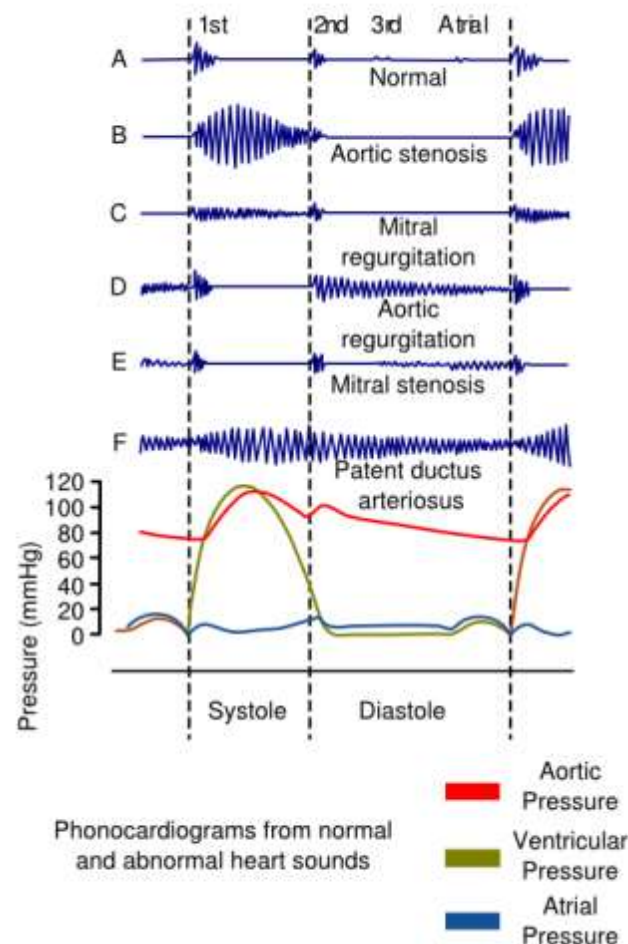
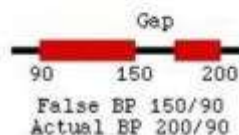
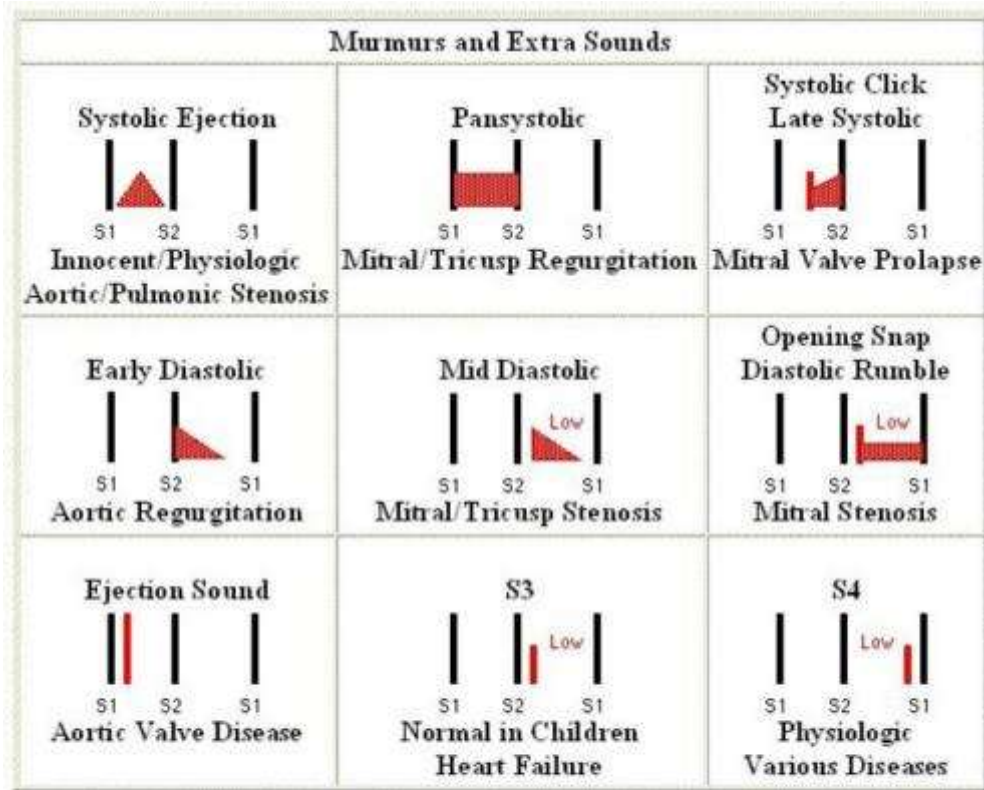


Heart failure: examination in right heart failure (anasarca)



Anasarka is whole body edema.

Heart failure: examination in right heart failure (heart sounds)



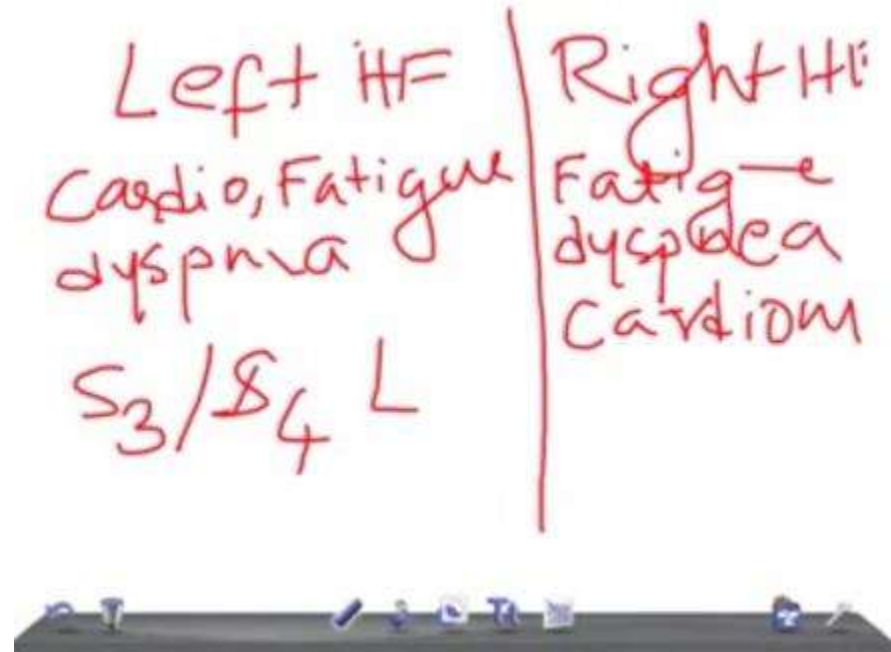
Heart failure: complications

- Kidney damage or failure
- Heart valve problems
- Heart rhythm problems
- Liver damage



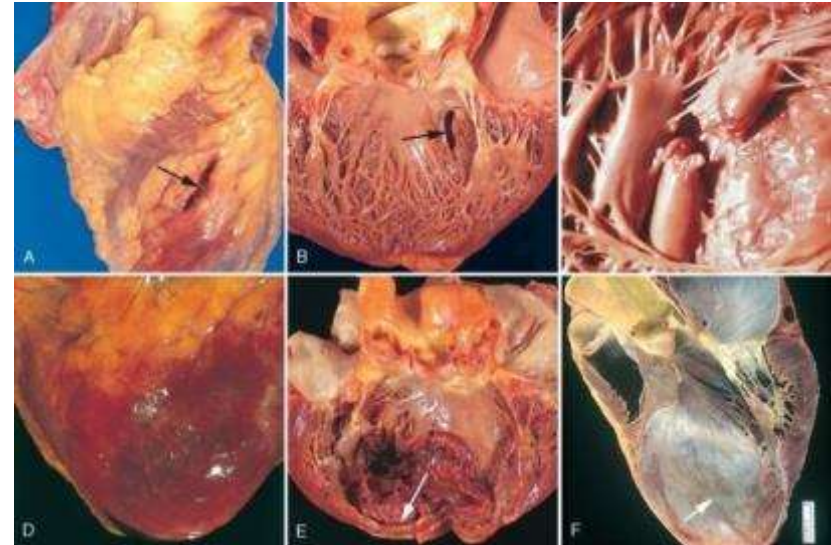
Heart failure: diagnosis

- Sometimes only clinical evaluation
- Chest x-ray
- Electrocardiography
- Echocardiography
- Cardiac radionuclide scan
- Magnetic resonance imaging
- Sometimes blood NP/BNP or N-terminal-pro-BNP (NT-pro-BNP) levels (other blood tests are not used for diagnosis but are useful for identifying cause of heart failure)
- Other tests for etiology as needed



Heart failure: diagnosis (clinical evaluation)

- Clinical findings suggest heart failure (HF) but are usually not apparent early
- Similar symptoms may result from chronic obstructive pulmonary disease (COPD) or recurrent pneumonia or may be erroneously attributed to obesity or old age
- Suspicion for HF should be high in patients with a history of myocardial infarction (MI), hypertension, or valvular disorders or murmurs and should be moderate in any patient who is elderly or has diabetes



Complications of acute myocardial infarction

- A. Anterior wall rupture
- B. Interventricular septum rupture
- C. Papillary muscle rupture
- D. Fibrinous pericarditis
- E. Mural thrombus
- F. Ventricular aneurysm

Heart failure: diagnosis (chest x-ray)

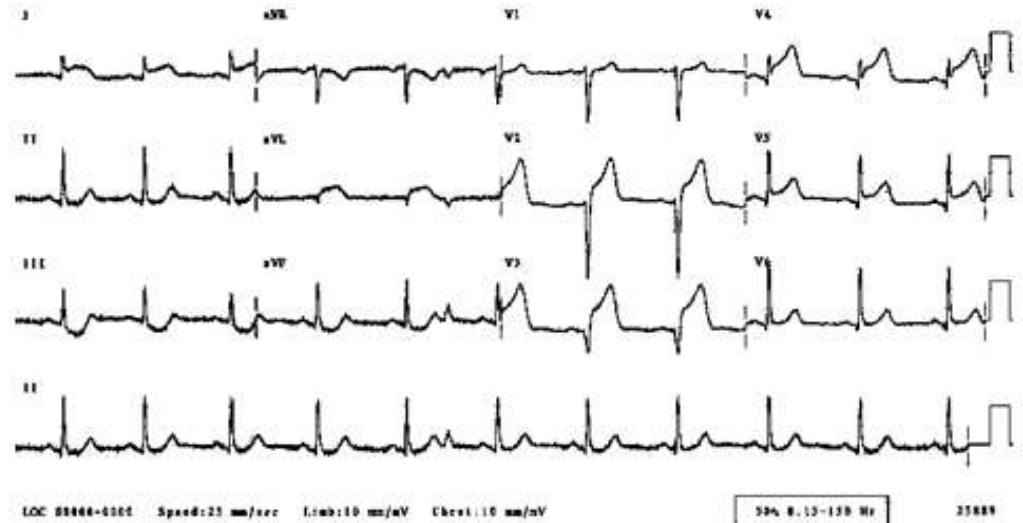
- Chest x-ray findings include an enlarged cardiac silhouette, pleural effusion, fluid in the major fissure, and horizontal lines in the periphery of lower posterior lung fields (Kerley B lines)
- Careful examination of the cardiac silhouette on a lateral projection can identify specific ventricular and atrial chamber enlargement
- The x-ray may also suggest alternative diagnoses (e.g., chronic obstructive pulmonary disease (COPD), pneumonia, interstitial pulmonary fibrosis, lung cancer)



Enlargement of the cardiac silhouette, increased pulmonary vasculature, and pleural effusions are evident in the patient suffering from congestive heart failure.

Heart failure: diagnosis (electrocardiography)

- Electrocardiography (ECG) findings are not diagnostic, but an abnormal ECG, especially showing previous myocardial infarction (MI), left ventricle (LV) hypertrophy, left bundle branch block, or tachyarrhythmia (e.g., rapid atrial fibrillation), increases suspicion for heart failure (HF) and may help identify the cause
- An entirely normal ECG is uncommon in chronic HF

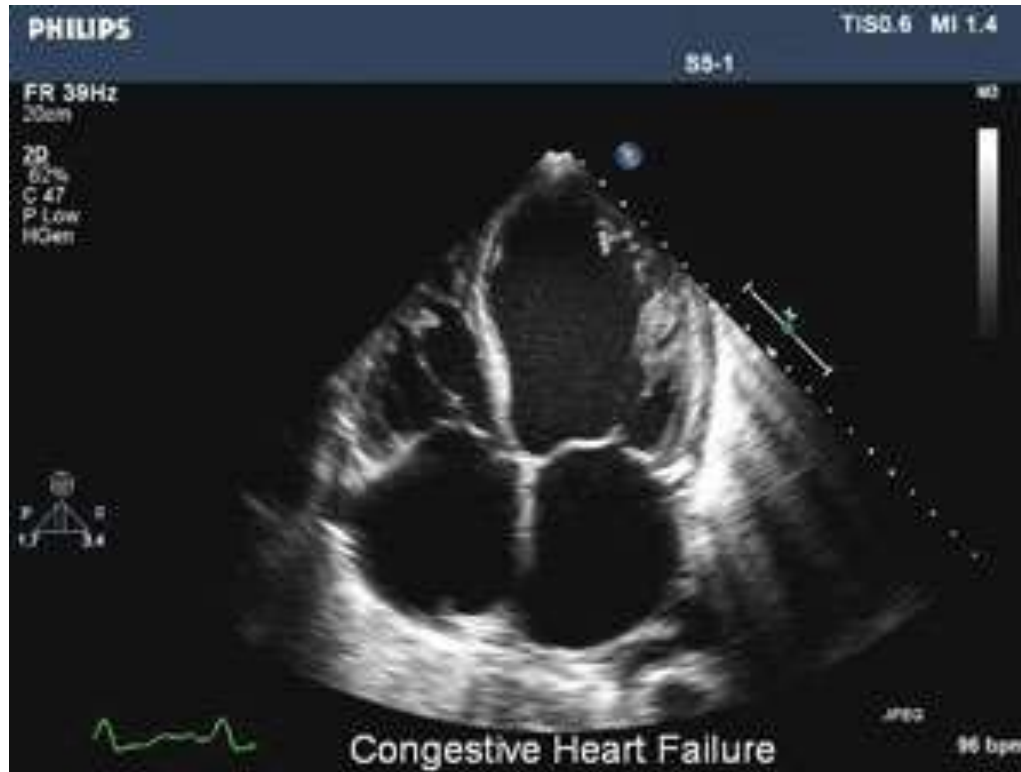


ECG showing myocardial infarction.

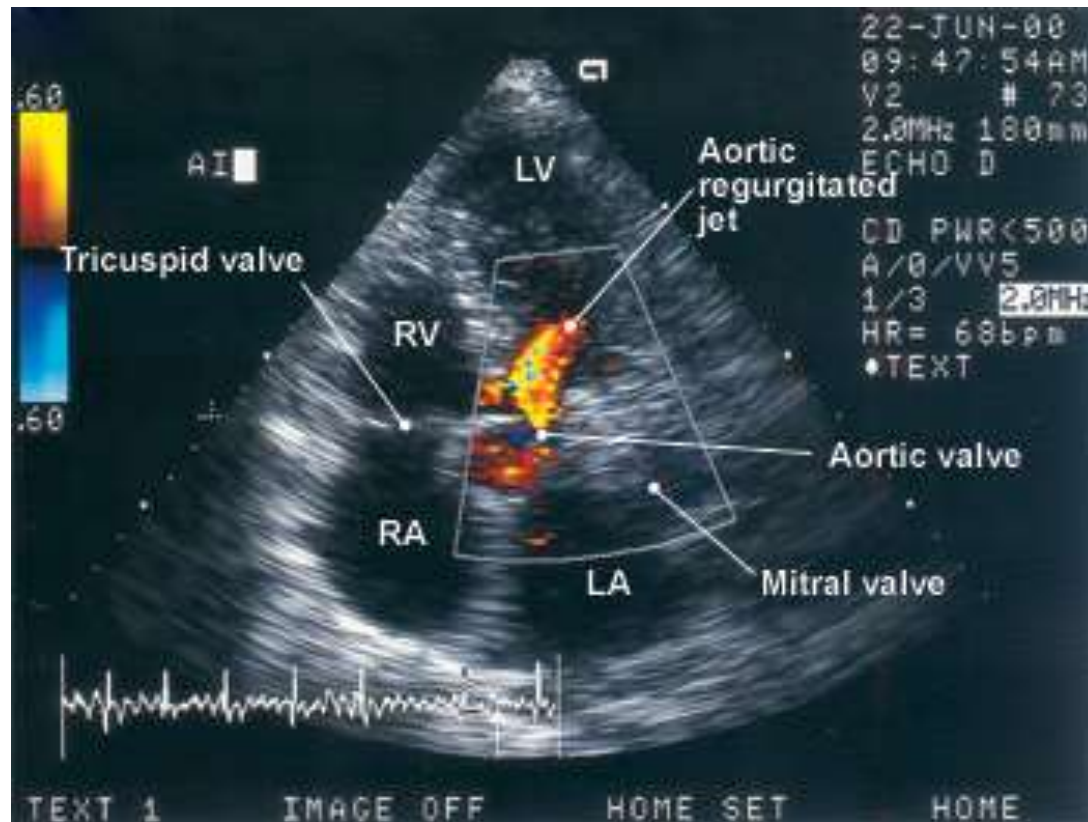
Heart failure: diagnosis (echocardiography)

- Echocardiography can help evaluate chamber dimensions, valve function, ejection fraction (EF), wall motion abnormalities, left ventricle (LV) hypertrophy, and pericardial effusion
- Measuring LV EF can distinguish between predominant diastolic dysfunction ($EF > 0.50$) and systolic dysfunction ($EF < 0.40$)
- Intracardiac thrombi, tumors, and calcifications within the heart valves, mitral annulus, and aortic wall abnormalities can be detected
- Localized or segmental wall motion abnormalities strongly suggest underlying coronary artery disease (CAD) but can also be present with patchy myocarditis
- Doppler echocardiography accurately detects valvular disorders and shunts, can help identify and quantify LV diastolic dysfunction

Heart failure: diagnosis (echocardiography)



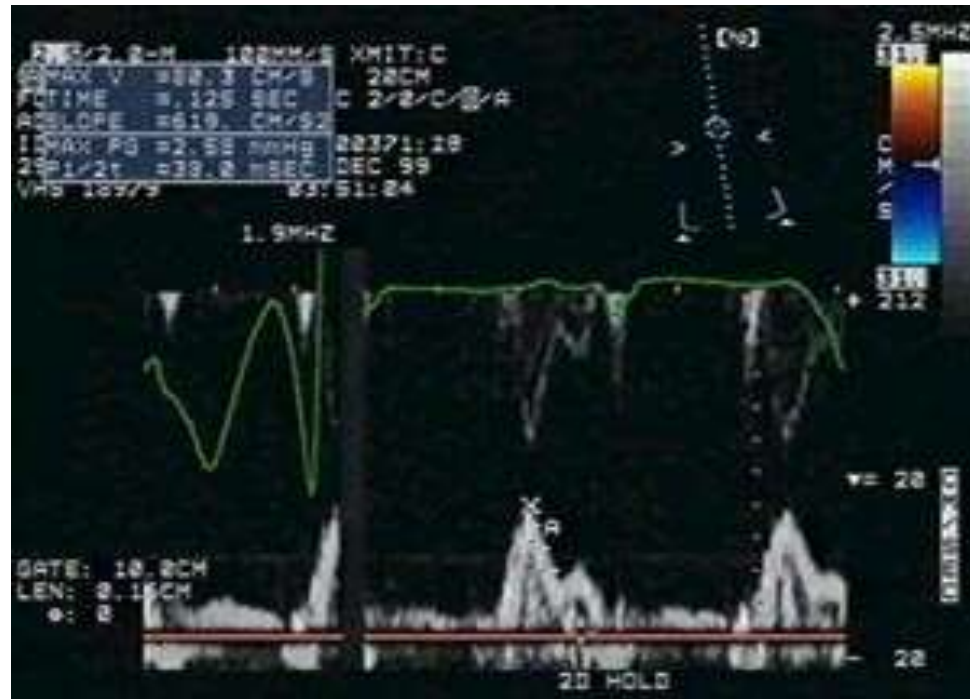
Heart failure: diagnosis (echocardiography)



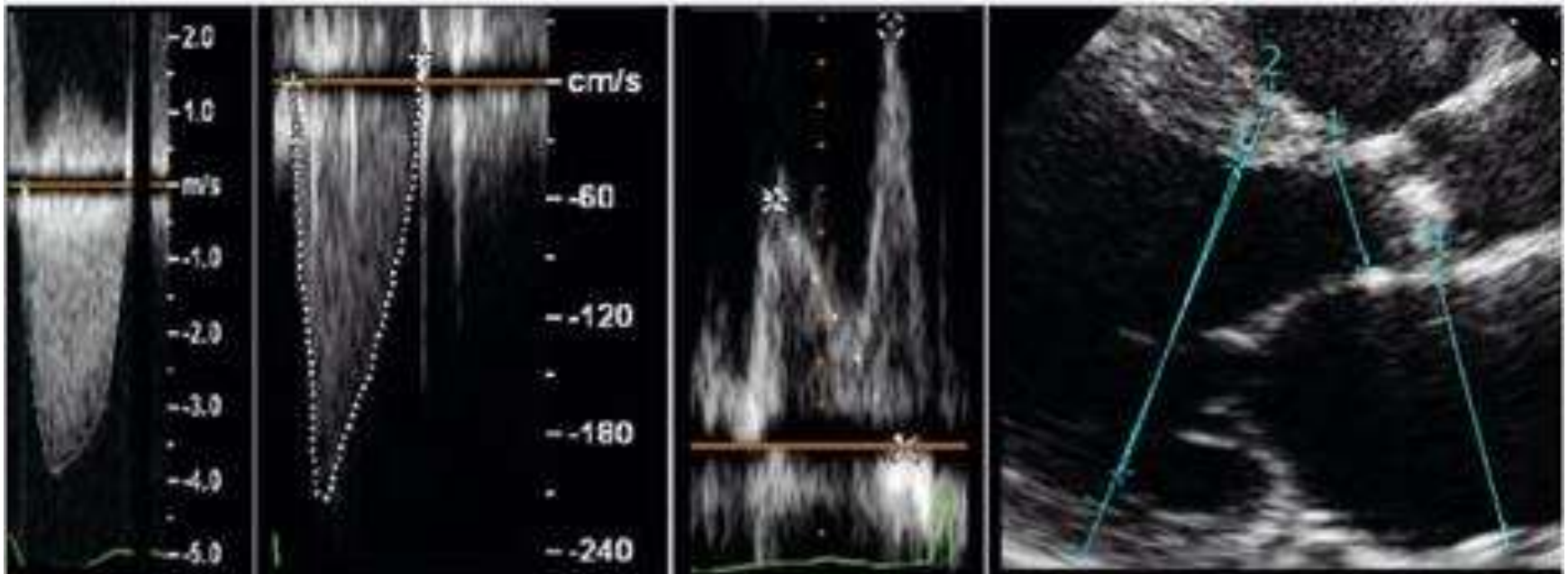
Heart failure: diagnosis (echocardiography)



Heart failure: diagnosis (echocardiography)

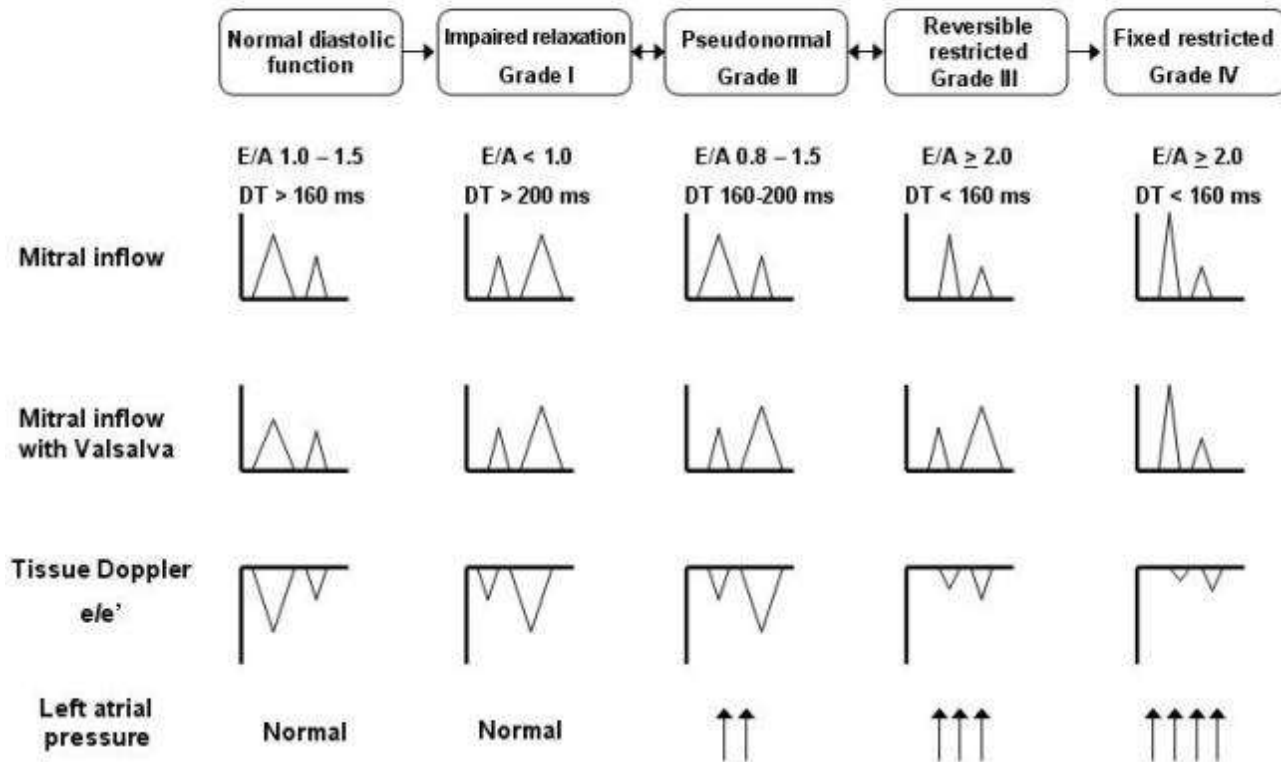


Heart failure: diagnosis (echocardiography)

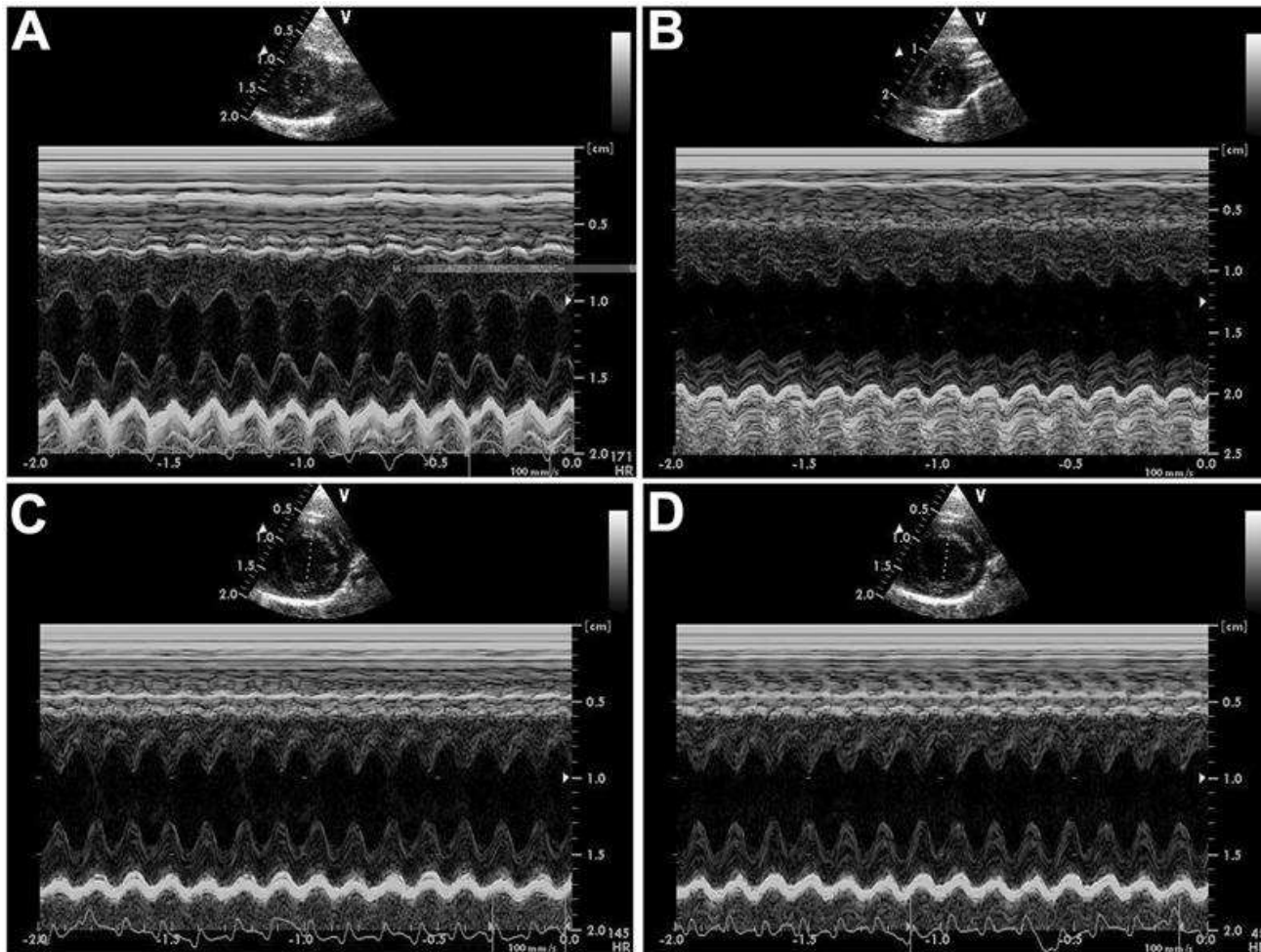


Heart failure: diagnosis (echocardiography)

Echocardiographic classification of diastolic dysfunction

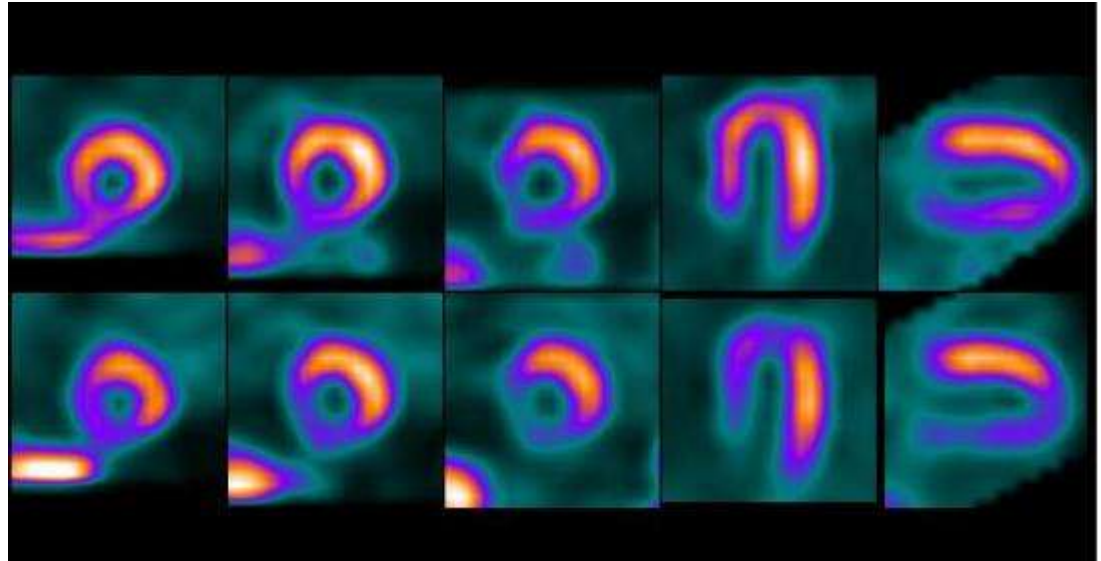


Heart failure: diagnosis (echocardiography)



Heart failure: diagnosis (cardiac radionuclide scan)

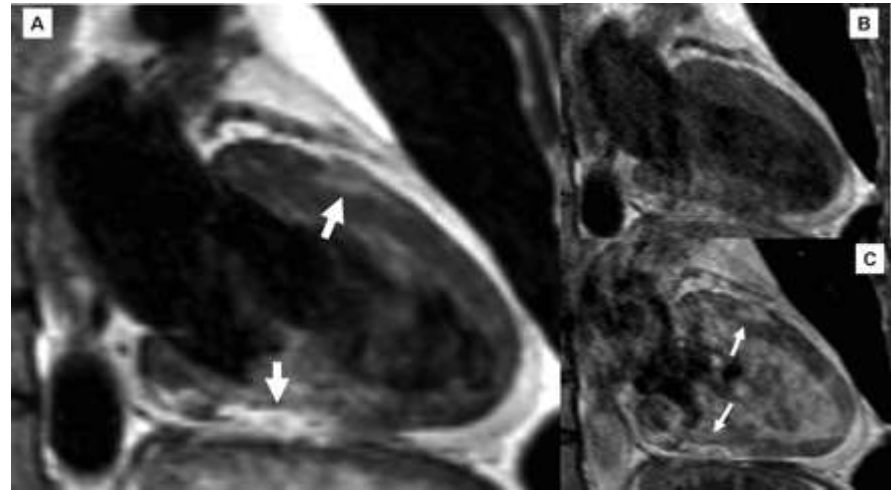
Radionuclide imaging can help assess systolic and diastolic function, previous myocardial infarction (MI), and inducible ischemia or myocardial hibernation



A myocardial perfusion SPECT (Single Photon Emission Computed Tomography) study, also called a cardiac stress-rest test, is used to evaluate the heart's blood supply. Two sets of images showing blood flow are obtained: the first following a period of rest, and the second following a period of stress, which involves exercise on a treadmill.

Heart failure: diagnosis (magnetic resonance imaging)

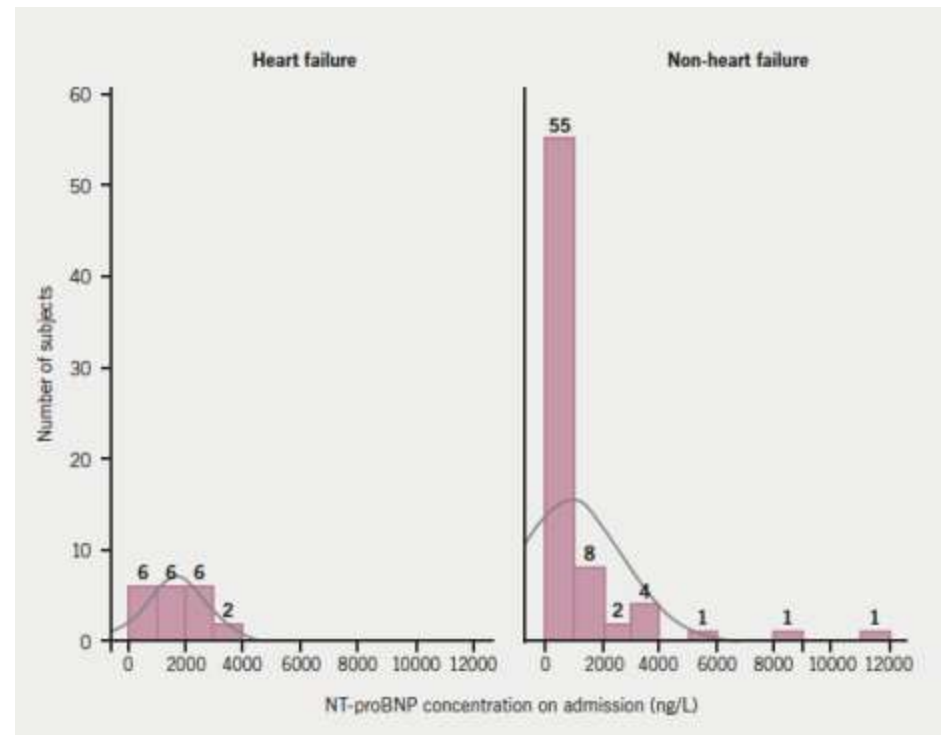
Cardiac magnetic resonance imaging (MRI) provides accurate images of cardiac structures and is becoming more widely available



T2-weighted dark-blood imaging of the left ventricular long axis showing high signal intensity in the left ventricular anterior and inferior wall, a sign of myocardial edema. A, T1-weighted dark-blood imaging (early enhancement) shows high signal intensity directly after gadolinium administration in the corresponding area of the anterior left ventricular wall. Arrows indicate myocardial edema. B, T1-weighted imaging before gadolinium administration. C, Arrows indicate myocardial early enhancement.

Heart failure: diagnosis (NP/BNP or N-terminal-pro-BNP levels)

- Serum NP/BNP levels are high in heart failure (HF); this finding may help when clinical findings are unclear or other diagnoses (e.g., chronic obstructive pulmonary disease (COPD)) need to be excluded
- It may be particularly useful for patients with a history of both pulmonary and cardiac disorders
- NT-pro-BNP, an inactive moiety created when pro BNP is cleaved, can be used similarly to NP/BNP



Heart failure: diagnosis (the Framingham criteria)

- Diagnosis of congestive heart failure requires the simultaneous presence of at least 2 of the following major criteria or 1 major criterion in conjunction with 2 of the following minor criteria
- Major criteria include an enlarged heart on a chest x-ray, an S3 gallop (a third heart sound), acute pulmonary edema, episodes of waking up from sleep gasping for air, crackles on lung auscultation, central venous pressure of more than 16 cm H₂O at the right atrium, jugular vein distension, positive abdomino jugular test, and weight loss of more than 4.5 kg in 5 days in response to treatment
- Minor criteria include an abnormally fast heart rate of more than 120 beats per minute, nocturnal cough, difficulty breathing with physical activity, pleural effusion, a decrease in the vital capacity by one third from maximum recorded, liver enlargement, and bilateral ankle swelling

Heart failure: stage (the American College of Cardiology classification)

Stage	Definition of Stage
A	High risk of heart failure (HF) but no structural heart disease or symptoms
B	Structural heart disease but no symptoms of HF
C	Structural heart disease with symptoms of HF
D	Refractory HF requiring specialized interventions

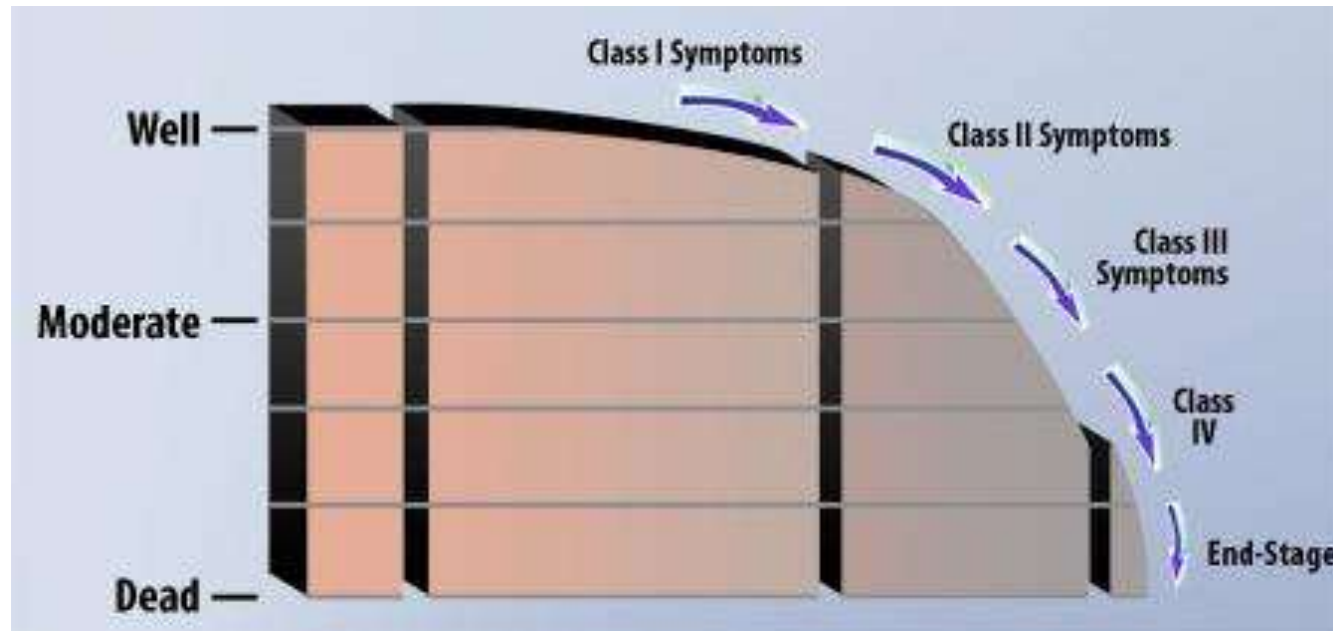
Medscape®	www.medscape.com
Stages of heart failure (CHF)	
A – Asymptomatic high risk patients	
B – Myocardial damage without symptoms	
C – LV systolic dysfunction and symptomatic CHF	
D – End-stage or refractory chronic heart failure	
Source: Geriatrics Aging © 2008 1453987 Ontario, Ltd.	

Heart failure:

Class (New York Heart Association (NYHA) Classification)

NYHA Class	Definition	Limitation
I	Ordinary physical activity does not cause undue fatigue, dyspnea, or palpitations.	None
II	Ordinary physical activity causes fatigue, dyspnea, palpitations, or angina.	Mild
III	Comfortable at rest; less than ordinary physical activity causes fatigue, dyspnea, palpitations, or angina.	Moderate
IV	Symptoms occur at rest; any physical activity increases discomfort.	Severe

Heart failure: Class (New York Heart Association (NYHA) Classification)

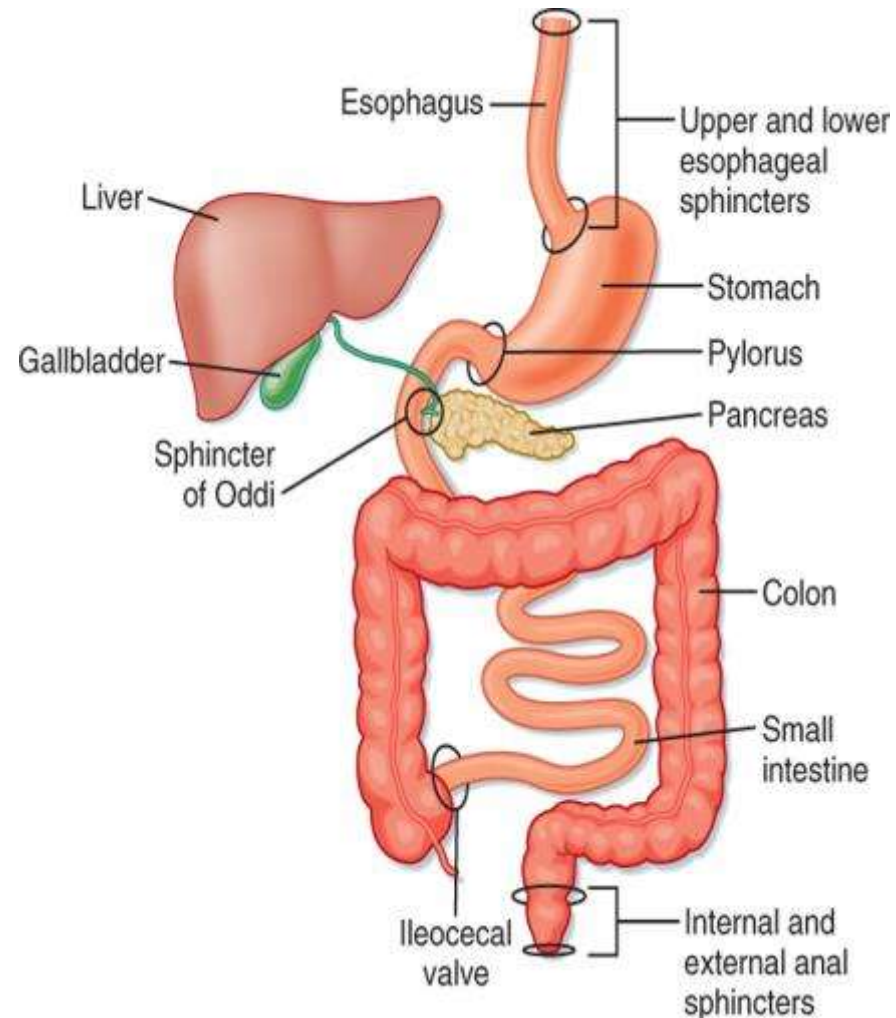


Lecture 13

Syndromes of gastrointestinal tract diseases

Plan of the lecture

- Definition of Gastrointestinal Tract
- Spectrum of Gastrointestinal Tract Disorders
 - Reminder (how do Gastrointestinal Tract works)
 - History-taking
 - Patient's examination (clinical, instrumental, laboratory)
 - Syndromes
 - esophagus and stomach disorders
 - intestine disorders
- Glossary of terms referred to endocrine diseases and metabolic disorders



Definition of the Gastrointestinal Tract

- The human gastrointestinal tract (GI tract, GIT) is an organ system responsible for consuming and digesting foodstuffs, absorbing nutrients, and expelling waste
- The tract consists of the stomach and intestines, and is divided into the upper and lower gastrointestinal tracts
- By the broadest definition, the GI tract includes all structures between the mouth and the anus
- The digestive system is a broader term that includes other structures, including the digestive organs and their accessories
- The tract may also be divided into foregut, midgut, and hindgut, reflecting the embryological origin of each segment
- The whole digestive tract is about nine meters (30 feet) long

Spectrum of the Gastrointestinal Tract Disorders

Esophagus

- Gastroesophageal Reflux Disease (GERD)
- Barrett's Esophagus
- Dysphagia
- Gastroesophageal Motility Disorders
- Benign/ malignant Esophageal Tumors
- Eosinophilic Esophagitis

Stomach

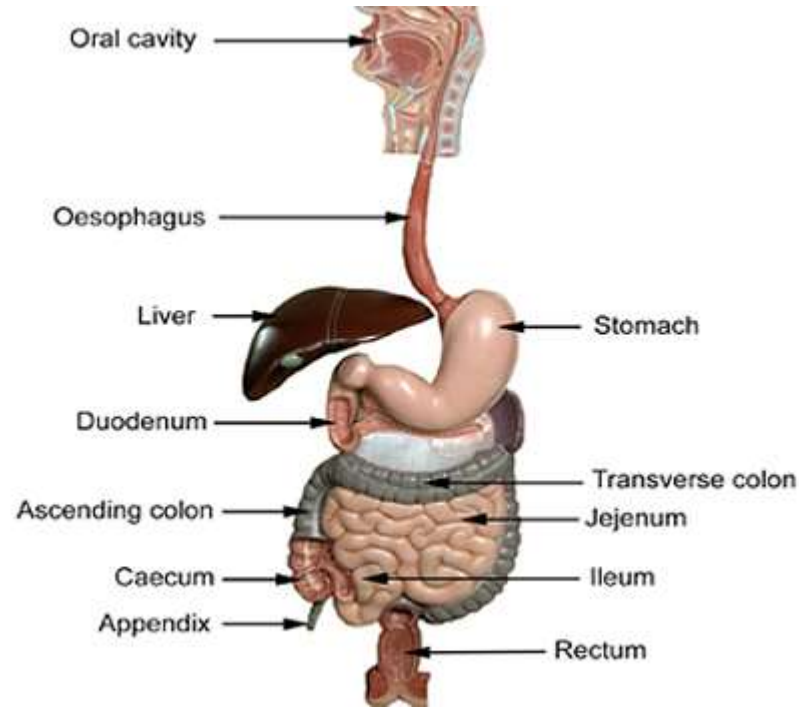
- Dyspepsia
- Cyclical Vomiting Syndrome

- Gastroparesis (Stomach Paralysis)
- Gastritis
- Ulcers
- Stomach Tumors

Bowel

- Inflammatory Bowel Disease
- Crohn's Disease
- Ulcerative Colitis
- Irritable Bowel Syndrome (IBS)
- Diverticulosis/Diverticulitis
- Celiac Disease
- Tumors
- Infections

Gastrointestinal Tract: Reminder



[How do Gastrointestinal Tract works](#)

Gastrointestinal Tract: History-taking

- Fever
- Acute/persistent diarrhea
- Persistent constipation
- Blood in stools (tarry stool)
- Persistent nausea or vomiting
- Vomiting blood
- Severe tenderness of the belly
- Unintended weight loss
- Symptom onset after age 50



- Dysphagia
- Anorexia or early satiety
- Prior Peptic Ulcer Disease history
- Jaundice
- Palpable abdominal mass
- Rectal bleeding

Gastrointestinal Tract: History-taking

Example of specific questions in chief complaint

- Character
- Location
- Severity
- Timing
- Duration
- Radiation
- Provocation
- Relieving conditions
- When did it first start?
- How often does it occur?
- Is appetite good or has it changed?
- What brought it on?
- Were there associated symptoms
- Is it becoming more frequent with time?
- Are the symptoms lasting longer?
- How are the symptoms related to food intake?

Gastrointestinal Tract: Clinical examination of the patient

- General inspection from the end of the bed
- General examination of:
 - Hands/pulse
 - Face
 - Lymph nodes
- Examination of the abdomen
 - Inspection
 - Palpation
 - Percussion
 - Auscultation



Gastrointestinal Tract: Instrumental examination of the patient

- Flat-plate film of the abdomen
- Computed tomography
- Magnetic resonance imaging
- Abdominal ultrasonography
- Color Doppler
- Endoscopic ultrasonography
- Endoscopic retrograde cholangiopancreatography (ERCP)



Gastrointestinal Tract: Laboratory examination of the patient

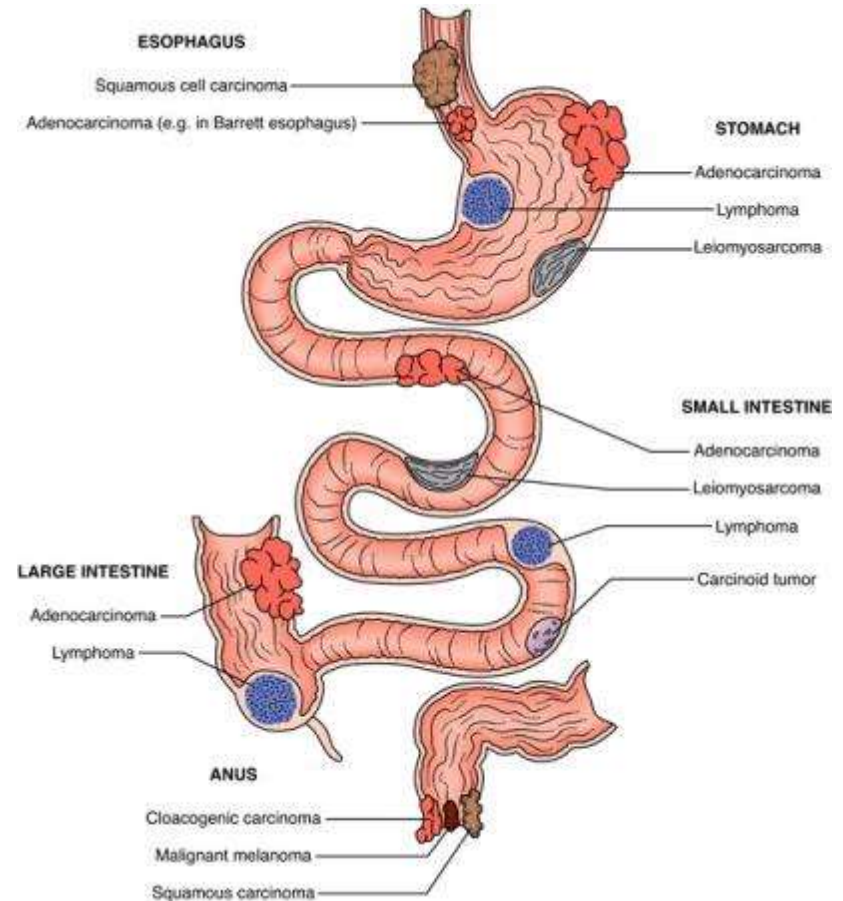
- Blood count
- Blood sugar tests
- Blood clotting factors
- Electrolytes
- Enzyme & protein blood tests
- Lipid blood tests
- C-reactive protein
- Fecal occult blood test
- Gut flora examination
- Ova and parasites exam
- Tests for *Clostridium difficile* infection
- Tests for *Helicobacter pylori* infection



Photo courtesy of Cepheid

Gastrointestinal Tract: Syndromes

- Esophagus motility disorders
- Stomach motility disorders
- Intestine motility disorders
- Maldigestion
- Malabsorption



Esophagus motility disorders: Definition

- An esophageal motility disorders are any medical disorders causing difficulty in swallowing, regurgitation of food and a spasm-type pain which can be brought on by an allergic reaction to certain foods
- The most prominent one is dysphagia
- It may be a part of CREST syndrome, refers to the five main features: calcinosis, Raynaud's phenomenon, Esophageal dysmotility, Sclerodactyly and Telangiectasia

Esophagus motility disorders



The typical picture of achalasia. Note the "bird-beak" appearance of the lower esophageal sphincter (LES), with a dilated, barium-filled esophagus proximal to it

Esophagus motility disorders: Types

- Dysphagia could be for Solid only or for Solid and liquid
- Solid Dysphagia is due to obstruction such as Esophageal Cancer, Esophageal web, or Stricture
- Solid plus liquid dysphagia is due to Esophageal motility disorder (or dysmotility) either *upper esophagus* (Myasthenia graves, stoke, or Dermatomyositis) or *lower esophagus* (systemic sclerosis, CREST syndrome, or Achalasia)

Esophagus motility disorders



The response to amyl nitrate (a smooth muscle relaxant), with partial relaxation of the lower esophageal sphincter (LES), allows some barium to pass through it into the stomach

Esophagus motility disorders: Causes

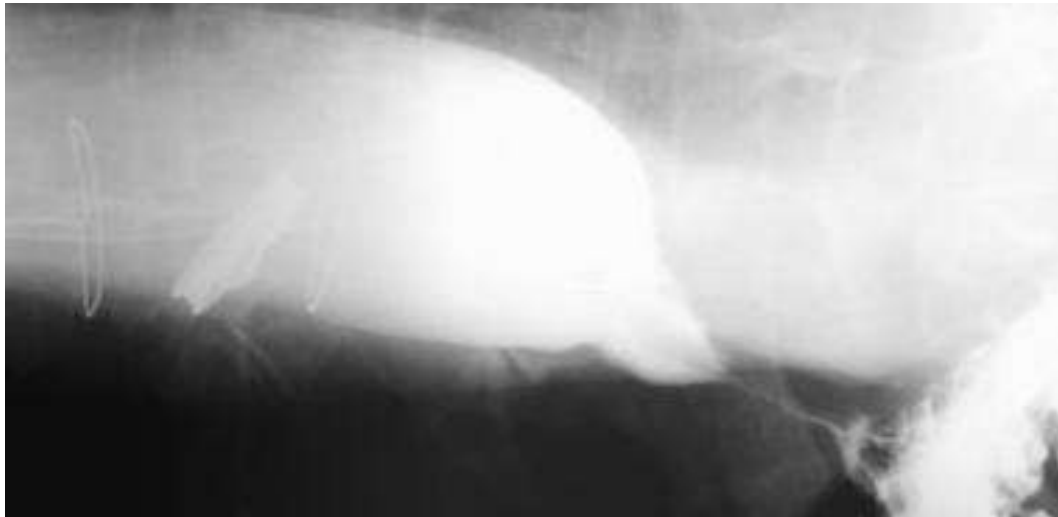
Primary

- Achalasia
- Diffuse esophageal spasm
- Eosinophilic esophagitis

By systemic disorders

- Systemic sclerosis
- Chagas
- etc.

Esophagus motility disorders



Esophagram of a 65-year-old man with rapid-onset dysphagia over 1 year: although esophagram shows a typical picture of achalasia, this patient had adenocarcinoma of the gastroesophageal junction. This is an example of pseudoachalasia, which reinforces the absolute need for esophagogastroduodenoscopy (EGD) in patients with radiologic diagnosis of achalasia

Esophagus motility disorders: Symptoms

- Difficulty swallowing liquids or solids (dysphagia)
- Regurgitation
- Heartburn
- Chest pain
- Atypical chest discomfort
- Vomiting
- A sensation of something getting stuck
- Weight loss

Esophagus motility disorders



An esophagram demonstrating the corkscrew esophagus picture observed in a patient with manometry confirmed findings of diffuse esophageal spasm (DES)

Esophagus motility disorders: Diagnosis

- In patients with primary motility disorders, results of a physical examination often are unrevealing
- Clinical signs of scleroderma in the proper clinical setting must be noted, especially skin changes
- A bedside swallowing challenge may be performed with a glass of water
- Check general nutrition and hydration if significant dysphagia is reported

Esophagus motility disorders



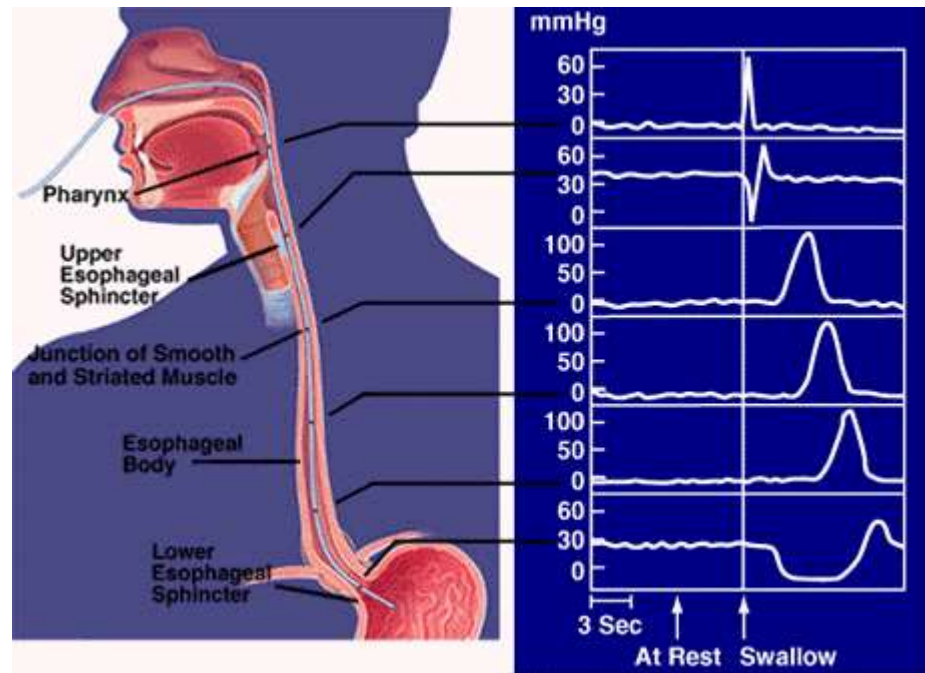
Response to amyl nitrate, with disappearance of the spasm on esophagram

Esophagus motility disorders:

Diagnostic procedures

- In patients with primary motility disorders, results of a physical examination often are unrevealing
- Clinical signs of scleroderma in the proper clinical setting must be noted, especially skin changes
- A bedside swallowing challenge may be performed with a glass of water
- Check general nutrition and hydration if significant dysphagia is reported
- Imaging Contrast Studies
- Esophageal manometry
- Acid- and reflux-related tests serve mainly to diagnose acid reflux into the esophagus

Esophagus motility disorders



Esophageal manometry testing, otherwise known as motility testing, is used to evaluate the neuromuscular functions of the esophagus

Stomach motility disorders:

Definition and types

- A gastric motility disorders are any alterations in the transit of foods and secretions into the digestive tract
- Types:
 - Delayed gastric emptying (gastroparesis)
 - Rapid gastric emptying (dumping syndrome)
 - Functional dyspepsia
 - Idiopathic vomiting
 - Cyclic vomiting syndrome

Stomach motility disorders: Causes

- Diabetes
- Infections
- Endocrine disorders (hypothyroidism, etc.)
- Connective tissue disorders (scleroderma, autoimmune conditions, neuromuscular diseases)
- Idiopathic (unknown causes)
- Psychological conditions
- Eating disorders
- Certain cancers
- Radiation treatment applied over the chest or abdomen
- Some chemotherapy agents
- Surgery of the upper intestinal tract

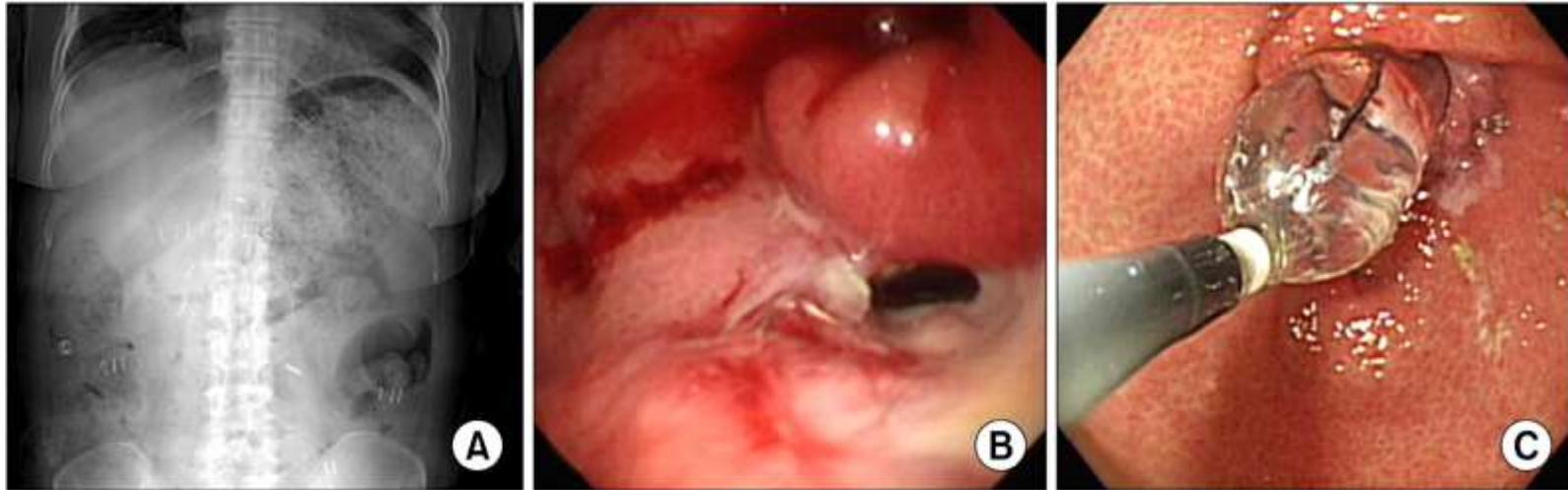
Stomach motility disorders:

Delayed gastric emptying (gastroparesis)

- Poor emptying of the stomach can occur for several reasons:
- The outlet of the stomach (the pylorus and duodenum) may be obstructed by an ulcer or tumor, or by something large and indigestible that was swallowed
- The pyloric sphincter at the exit of the stomach may not open enough or at the right times to allow food to pass through (the normally rhythmic, 3 per minute contractions of the lower part of the stomach can become disorganized so that the contents of the stomach are not pushed towards the pyloric sphincter)

Stomach motility disorders:

Delayed gastric emptying (gastroparesis)



Radiologic and endoscopic finding of delayed gastric emptying. (A) Simple abdomen X-ray shows dilated stomach with food material. (B) Severe stenosis of anastomosis site after Billroth I gastroduodenostomy. Opening is seen at inferior direction of anastomosis site. Opening was too small for endoscope to pass through. Ulcer lesion is seen below anastomotic site. (C) Endoscopic view of gastroduodenostomy stenosis undergoing balloon dilatation. Luminal narrowing is seen due to anastomotic stenosis. Balloon dilatation by 20→25→30 psi was done for 2 minutes. There developed no complication such as bleeding due to procedure. Widening of stenosis site can be seen.

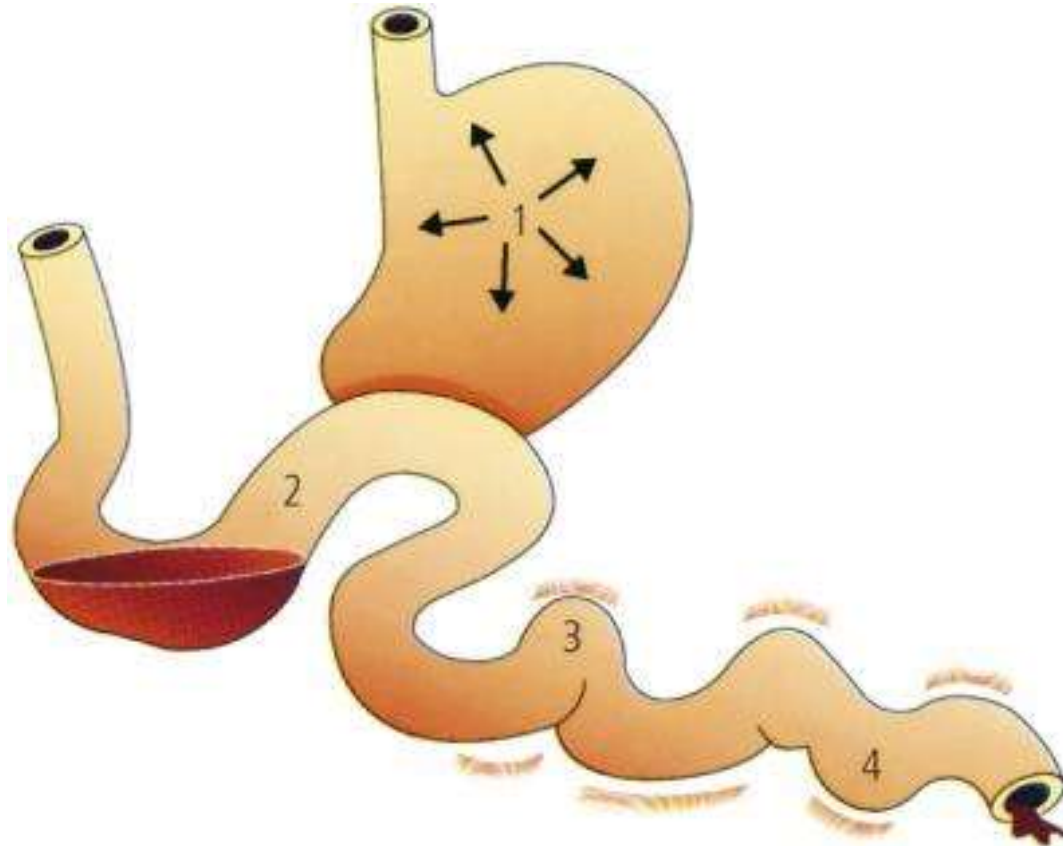
Stomach motility disorders:

Rapid gastric emptying (dumping syndrome)

- Rapid gastric emptying, or dumping syndrome, happens when the upper end of the small intestine (jejunum) fills too quickly with undigested food from the stomach
- "Early" dumping begins during or right after a meal
- "Late" dumping happens 1 to 3 hours after eating
- Many people have both type

Stomach motility disorders:

Delayed gastric emptying (gastroparesis)



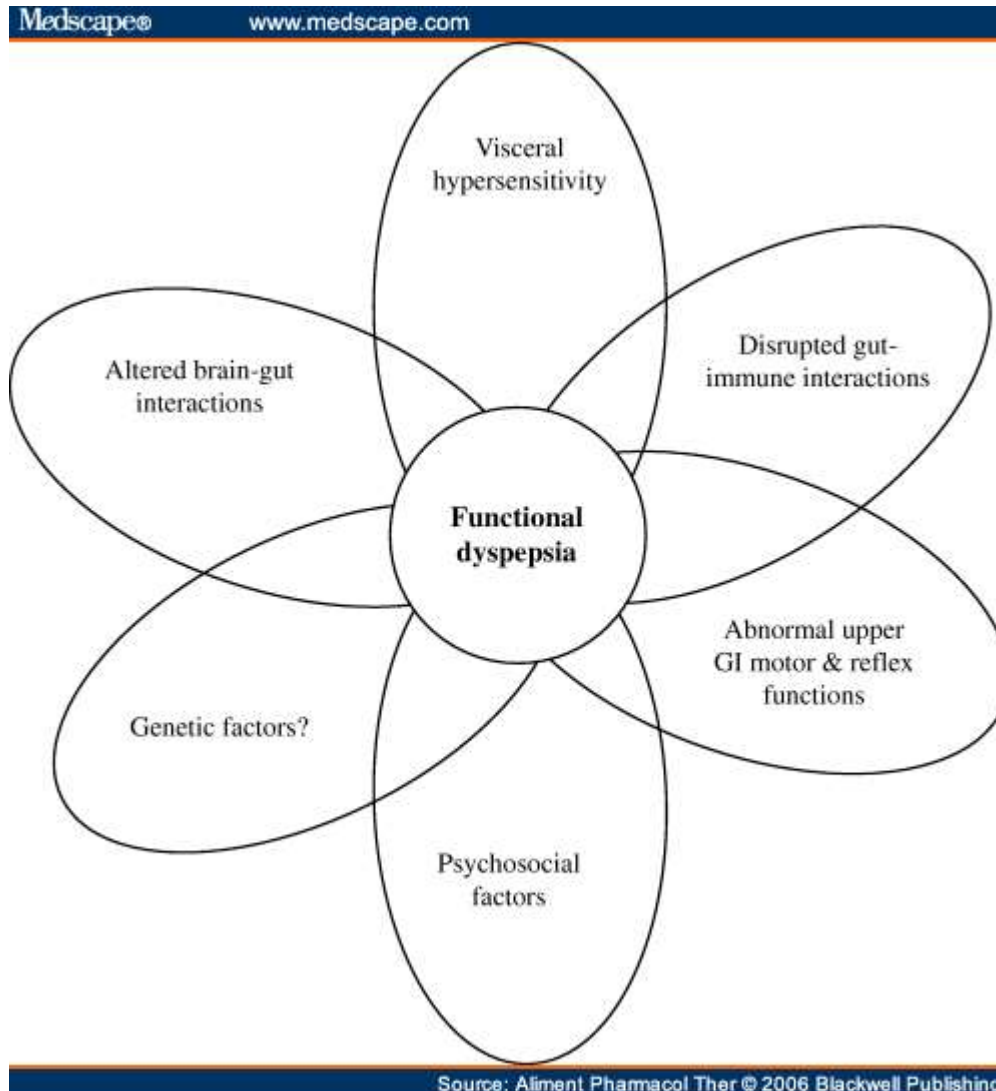
Stomach motility disorders:

Functional dyspepsia

- Many patients have pain or discomfort (fullness, early satiety (feeling full soon after starting to eat), bloating, nausea) that is felt in the center of the abdomen above the belly button
- There is no single motility disorder that explains all these symptoms, but about a third of patients with these symptoms have delayed gastric emptying (usually not so severe that it causes frequent vomiting), and about a third show a failure of the relaxation of the upper stomach following a swallow (abnormal gastric accommodation reflex)
- About half of the patients with these symptoms also have a sensitive or irritable stomach, which causes sensations of discomfort when the stomach is filled with even small volumes

Stomach motility disorders:

Functional dyspepsia



Stomach motility disorders:

Cyclic vomiting syndrome (CVS)

- Cyclic vomiting syndrome (CVS) is a disorder with recurrent episodes of severe nausea and vomiting interspersed with symptom free periods
- CVS occurs in all ages
- Patients may struggle for many years before a correct diagnosis is made.

Stomach motility disorders: Symptoms

- Nausea and/or vomiting
- Retching (dry heaves)
- Bloating
- Upper abdominal pain
- Stomach fullness after a normal sized meal
- Early fullness (satiety) with the inability to finish a meal
- Weight loss due to a decreased appetite

Stomach motility disorders:

Gastric Motility Procedures

- SmartPill Wireless Motility Capsule is a pill-sized sensor that is swallowed and measures temperature, pH, pressure, how quickly the stomach empties, how quickly the small intestine and colon empty
- Helicobacter Pylori (H. Pylori) Testing can be done with a blood antibody test, breath test, stool antigen test or stomach biopsy
- Breath Testing that can help detect a food intolerance, bacterial overgrowth, irritable bowel syndrome (IBS), fructose intolerance, lactose intolerance, constipation

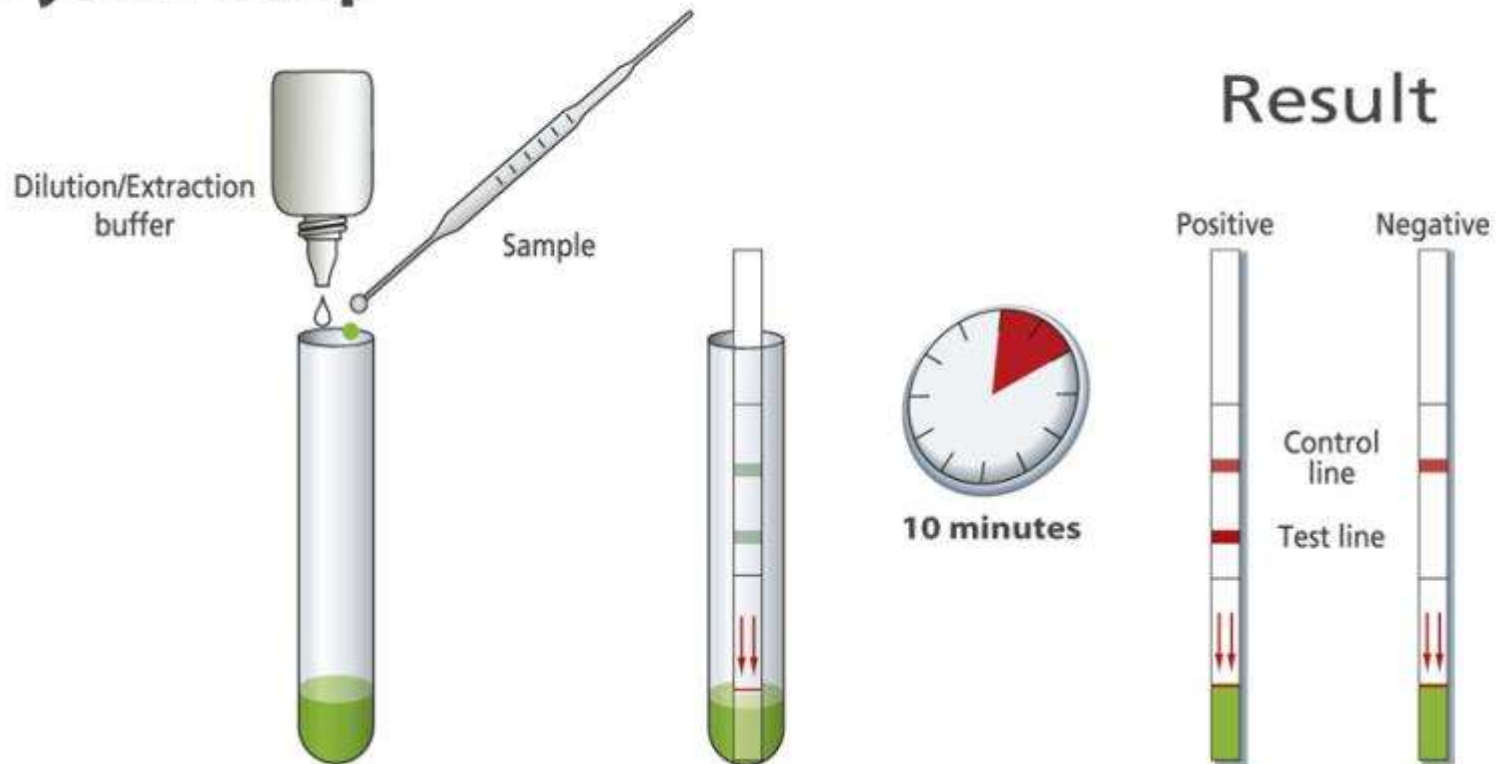
Stomach motility disorders: SmartPill Wireless Motility Capsule



Stomach motility disorders:

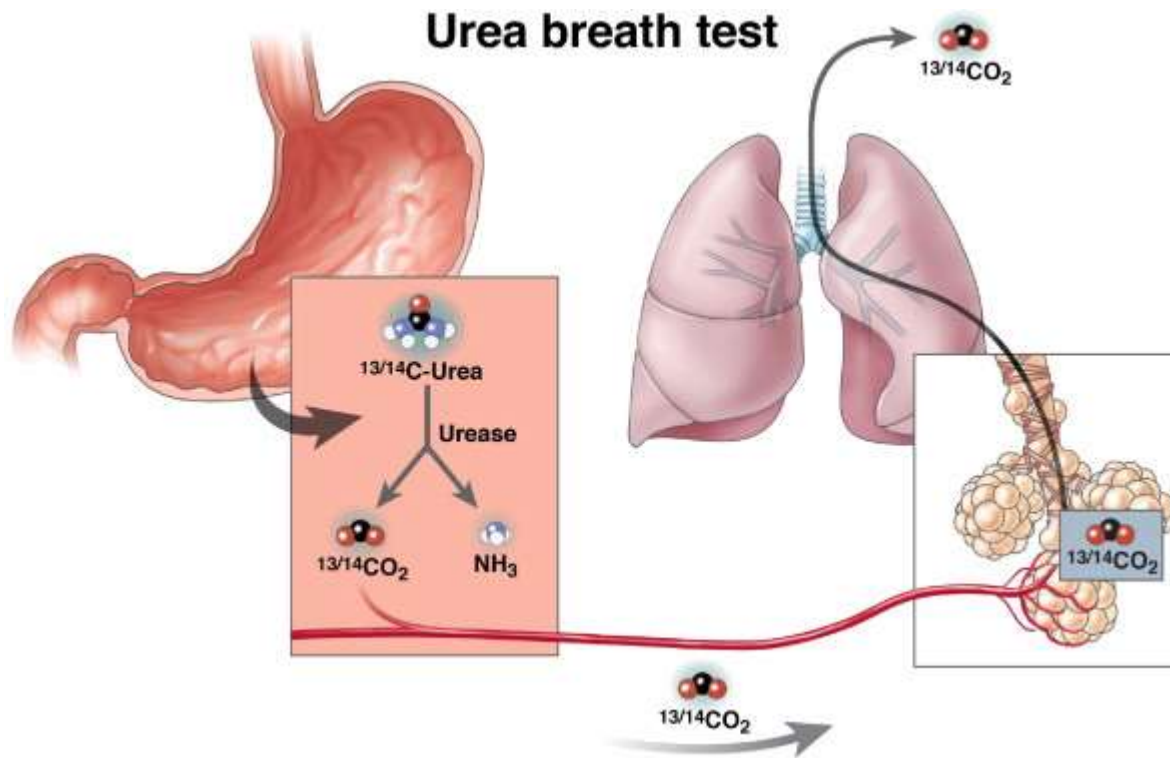
Helicobacter Pylori (H. Pylori) Testing

Pylori-Strip



Stomach motility disorders:

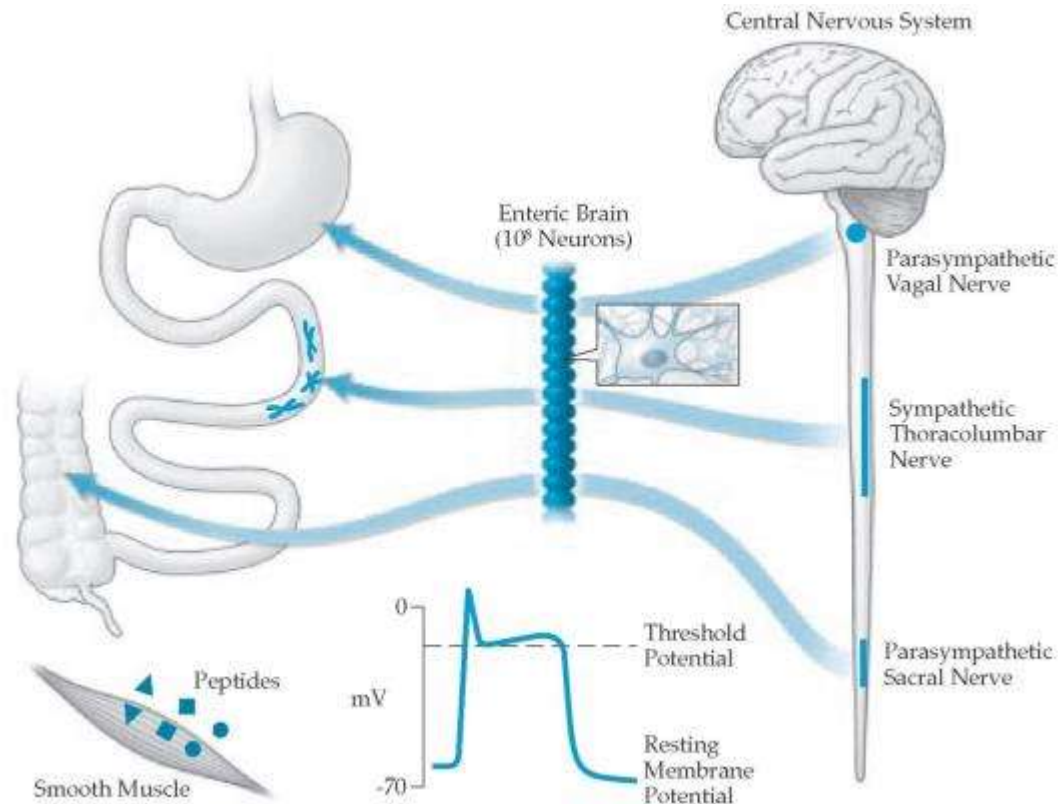
Helicobacter Pylori Breath Testing



Intestine motility disorders: Definition

- The phrase intestinal motility disorders applies to abnormal intestinal contractions, such as spasms and intestinal paralysis
- This phrase is used to describe a variety of disorders in which the gut has lost its ability to coordinate muscular activity because of endogenous or exogenous causes

Intestine motility disorders: To mechanisms



Control of gut motility: interactions between extrinsic neural pathways and the intrinsic nervous system

Intestine motility disorders: Causes

- Causes seem to be multifactorial, and only a few have been detected
- Degenerative disorders cause pseudo-obstruction along with other problems
- Drugs that are commonly used (e.g., tricyclic antidepressants, diuretics, laxatives) or have specific indications (e.g., lithium salts, vinca alkaloids, and other chemotherapy agents) may interfere with intestinal motility
- Endocrine disorders (e.g., myxedema) can also cause pseudo-obstruction
- Genetic factors

Intestine motility disorders: Manifestation

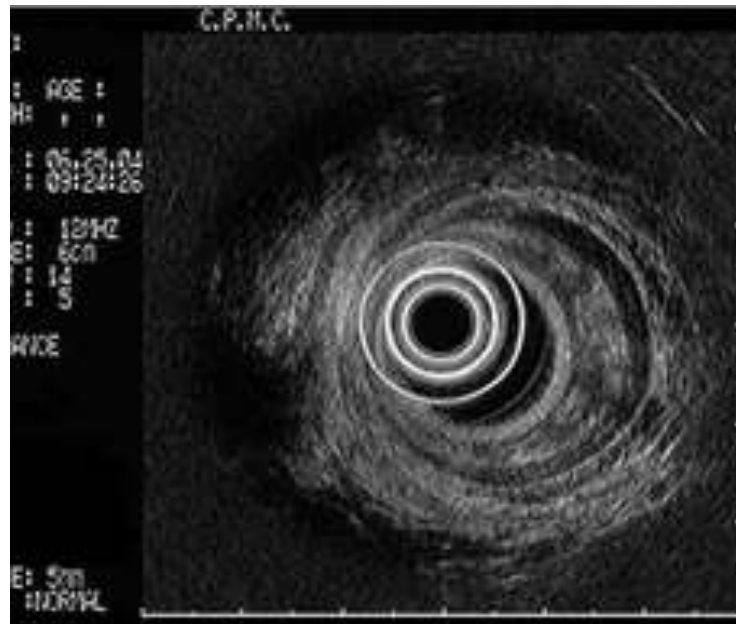
- Abdominal distention
- Recurrent obstruction
- Severe abdominal colicky pain
- Severe constipation
- Gastroesophageal reflux disease
- Intractable, recurrent vomiting

Intestine motility disorders: Clinical forms

- Intestinal pseudo-obstruction (Ogilvie syndrome)
- Irritable bowel syndrome (IBS)
- Fecal incontinence
- Constipation

Intestine motility disorders:

Endoscopic ultrasound



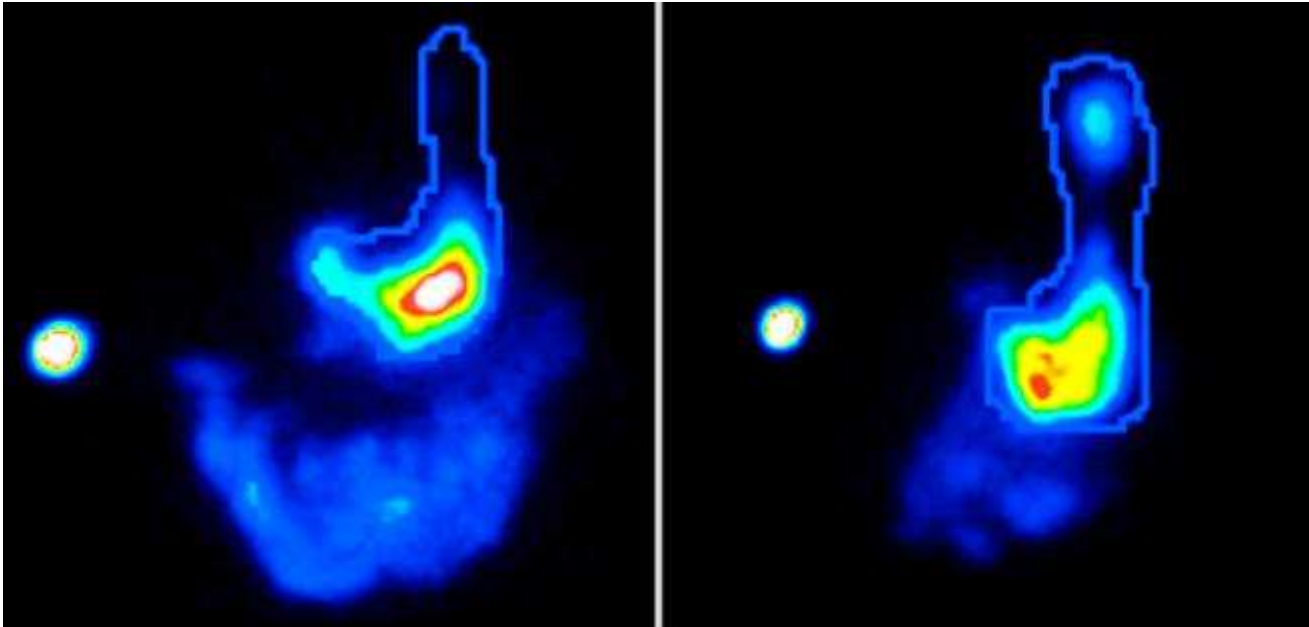
Anterior defect in internal and external anal sphincter

Intestine motility disorders:

The Knowles-Martin classification

- Delayed colonic transit - slow transit constipation (e.g., enteric neuropathy, enteric myopathy, Parkinson disease, endocrine disorders, spinal injury)
- Dilated colon (diffuse or segmental) - Ogilvie syndrome, megacolon
- Absent rectoanal inhibitory reflex - Hirschsprung disease

Intestine motility disorders: Gastrointestinal scintigraphy



In these two-hour images, note the normal emptying (51 percent empty, normal range 31-67 percent) in the left image, with significantly more tracer shown in the small intestine than in the right image, which shows delayed emptying (26 percent empty) and much less tracer in the intestine.

Intestine motility disorders: Symptoms

- Pain
- Bloating
- Disturbed bowel motion
- Feeling full after having eaten only a small amount
- Nausea
- Vomiting
- Severe constipation

Intestine motility disorders:

Diagnostic Motility Testing



Placement of guide wire for
motility catheter



Placement of colonic motility
catheter

Intestine motility disorders:

Physical examination

- The clinical picture of patients with intestinal motility disorders is protean and may vary greatly, depending on the specific condition present
- Always perform a digital rectal examination in any patient with an intestinal motility disorder to detect the presence of a mass (e.g., feces, tumor, or a foreign body) or blood in the rectum

Intestine motility disorders: Diagnostic Testing - Defecography



Anterior rectocele

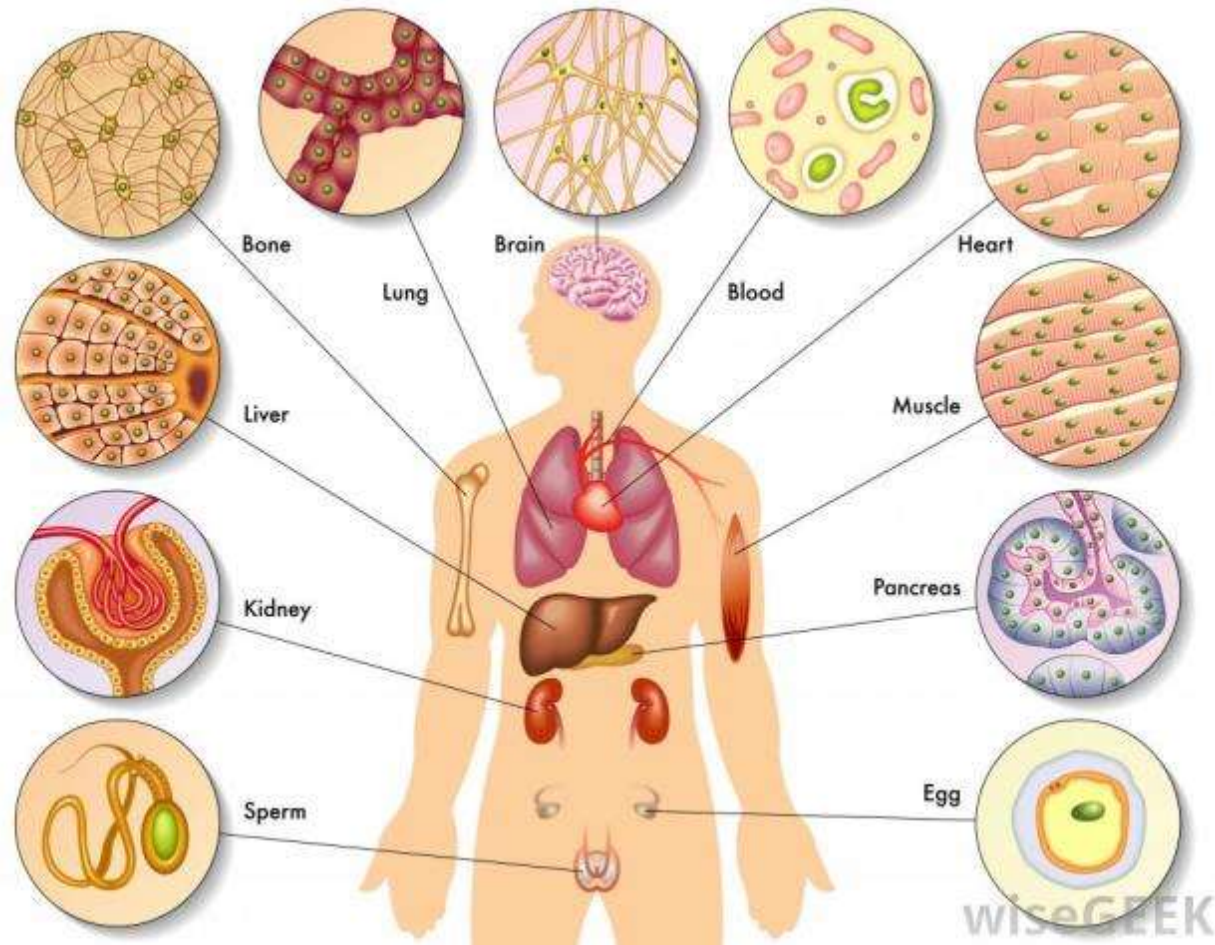


Anterior rectocele that does
not empty

Maldigestion/malabsorption: Definition

- Maldigestion describes the inability of an individual to digest food in the gut
- Malabsorption is the inability to absorb nutrients which have been digested from food through the gut

Maldigestion/malabsorption: Organs damage



Maldigestion/malabsorption: Causes

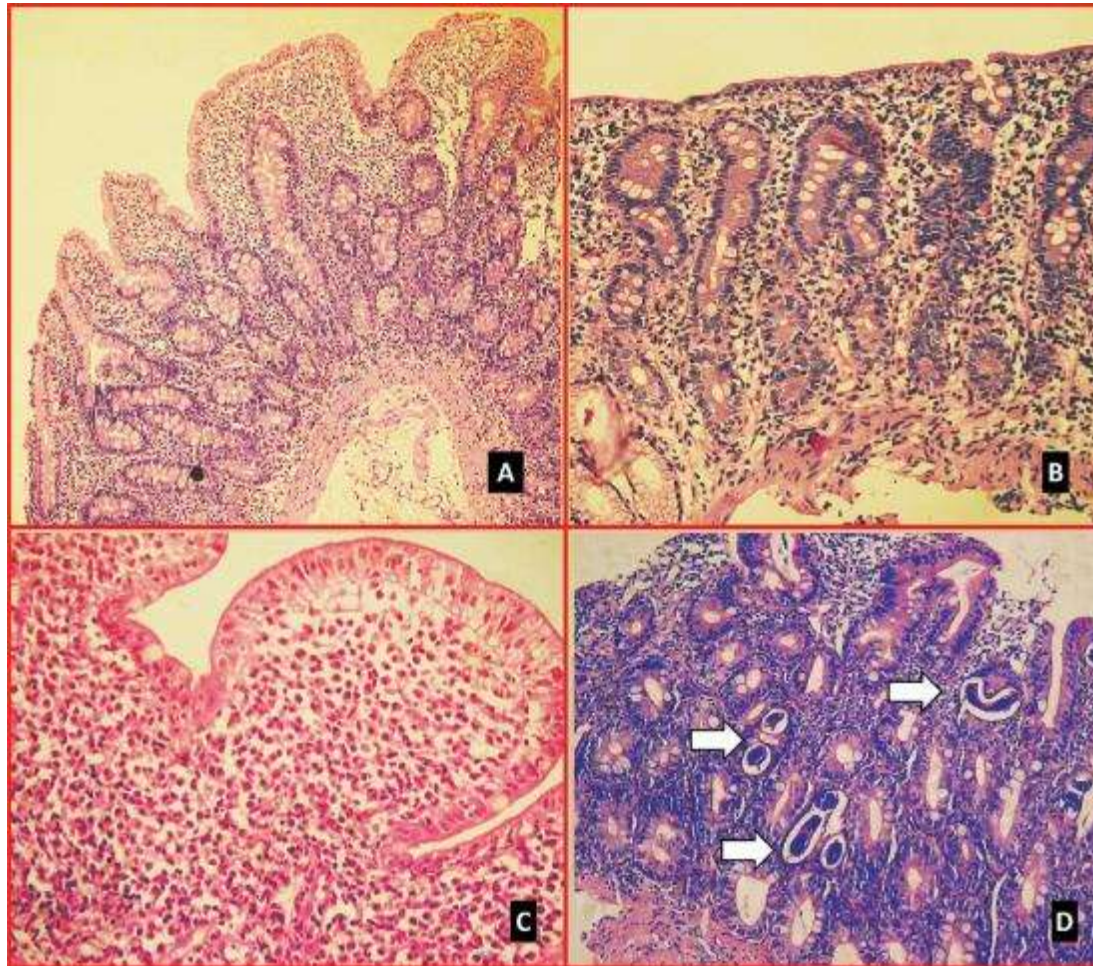
- Congenital heart disease
- Cystic fibrosis
- Gastroenteritis
- HIV infection
- Liver disease
- Short-bowel syndrome
- Toddlers diarrhoea
- etc.

Maldigestion/malabsorption: Symptoms

(Gastrointestinal manifestations)

- Diarrhea
- Steatorrhea
- Weight loss
- Flatulence
- Abdominal bloating
- Abdominal cramps
- Pain
- Abdominal discomfort
- Swelling or oedema
- Muscle cramp^s

Maldigestion/malabsorption: Histological examination

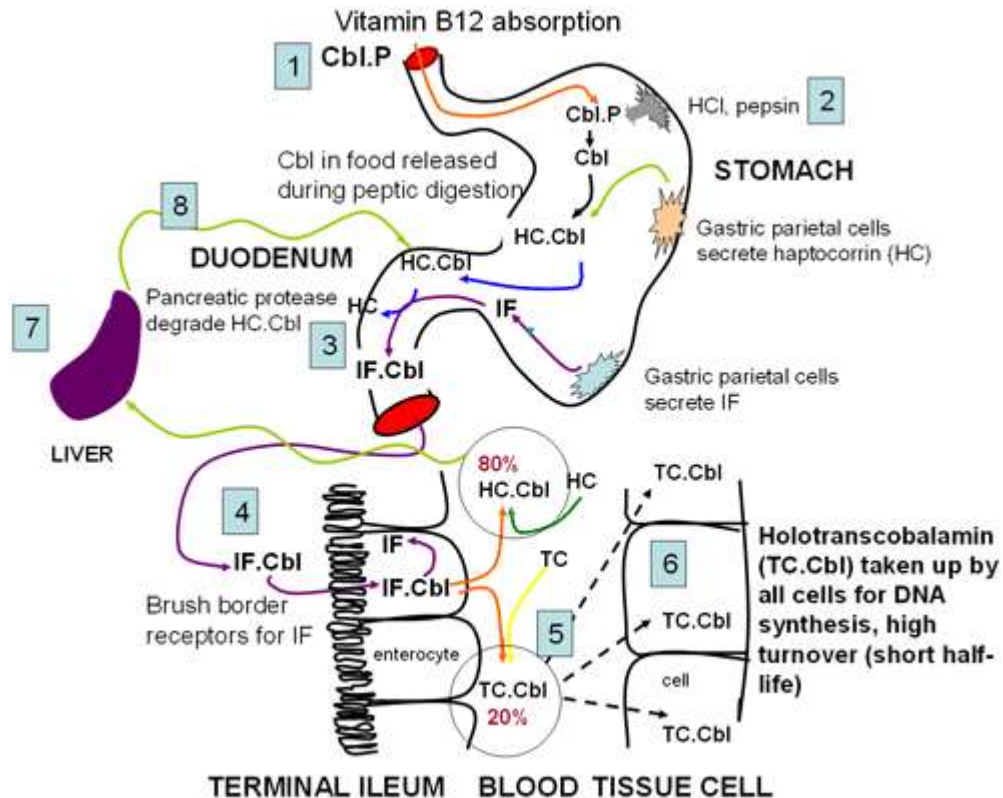


Maldigestion/malabsorption: Symptoms

(Extraintestinal manifestations)

- Substantial numbers of patients with intestinal malabsorption present initially with symptoms or laboratory abnormalities that point to other organ systems in the absence of or overshadowing symptoms referable to the gastrointestinal tract
- Patients with coeliac disease present with anemia and osteopenia in the absence of classic gastrointestinal symptoms
- Microcytic, macrocytic, or dimorphic anemia may reflect impaired iron, folate, or vitamin B12 absorption
- Purpura, subconjunctival hemorrhage may reflect hypoprothrombinemia secondary to vitamin K malabsorption
- Osteopenia is common, especially in the presence of steatorrhea. Impaired calcium and vitamin D absorption and chelation of calcium by unabsorbed fatty acids resulting in fecal loss of calcium may all contribute
- Dermatitis and peripheral neuropathy may be caused by malabsorption of specific vitamins or micronutrients and essential fatty acids

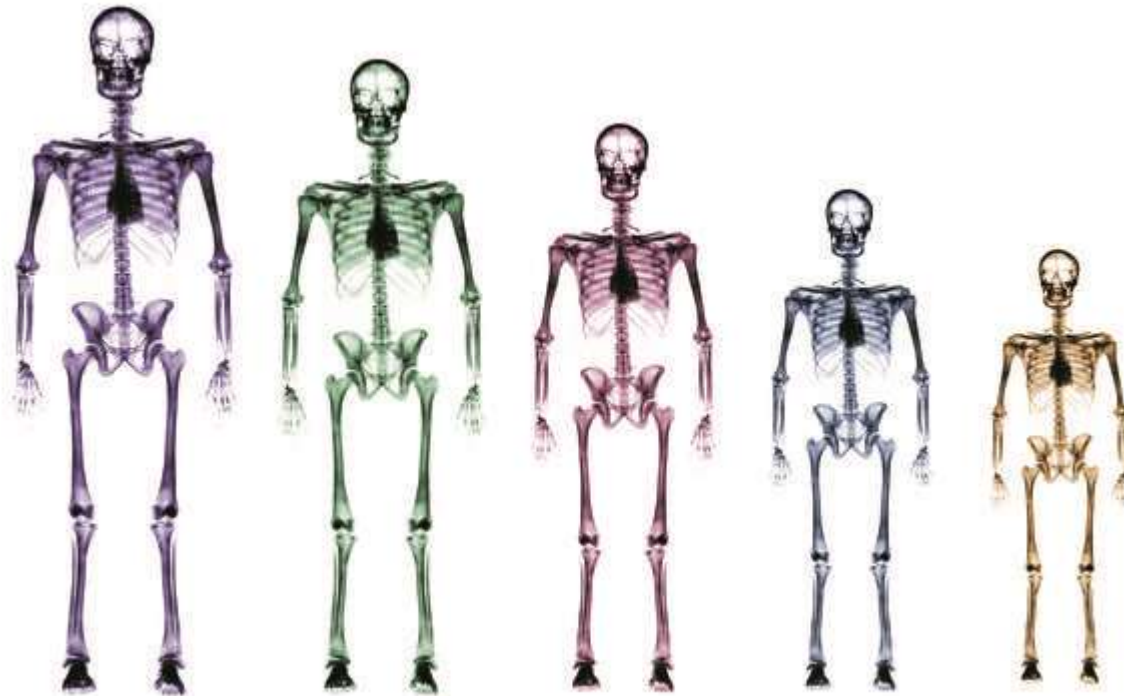
Maldigestion/malabsorption: B12 Deficiency



Maldigestion/malabsorption: Complications

- Both maldigestion and malabsorption can lead to deficiencies, for example in vitamins and minerals as well as protein and energy
- The complications that can develop depend upon which nutrients are affected
- For example, a calcium and vitamin D deficit can lead to rickets and osteopenia
- Iron deficiency is associated with anaemia
- Zinc deficiency has been linked to poor growth
- Problems with absorbing protein, fats and carbohydrates can culminate in weight loss and undernutrition with wasting and in severe cases stunting

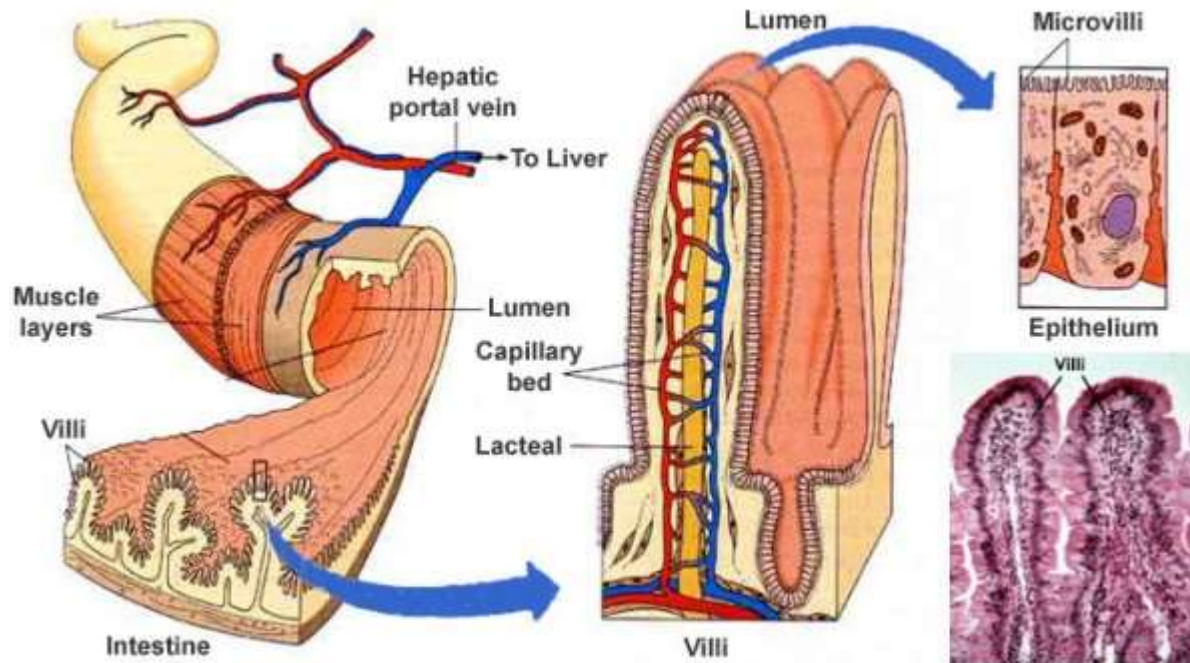
Malabsorption of vitamin D



Maldigestion/malabsorption: Diagnosis

- There is no single, specific test
- A range of different conditions can produce maldigestion/malabsorption and it is necessary to look for each of these specifically
- Many tests have been advocated, and some, such as tests for pancreatic function are complex, vary between centers and have not been widely adopted
- Tests are also needed to detect the systemic effects of deficiency of the malabsorbed nutrients (such as anaemia with vitamin B12 malabsorption)

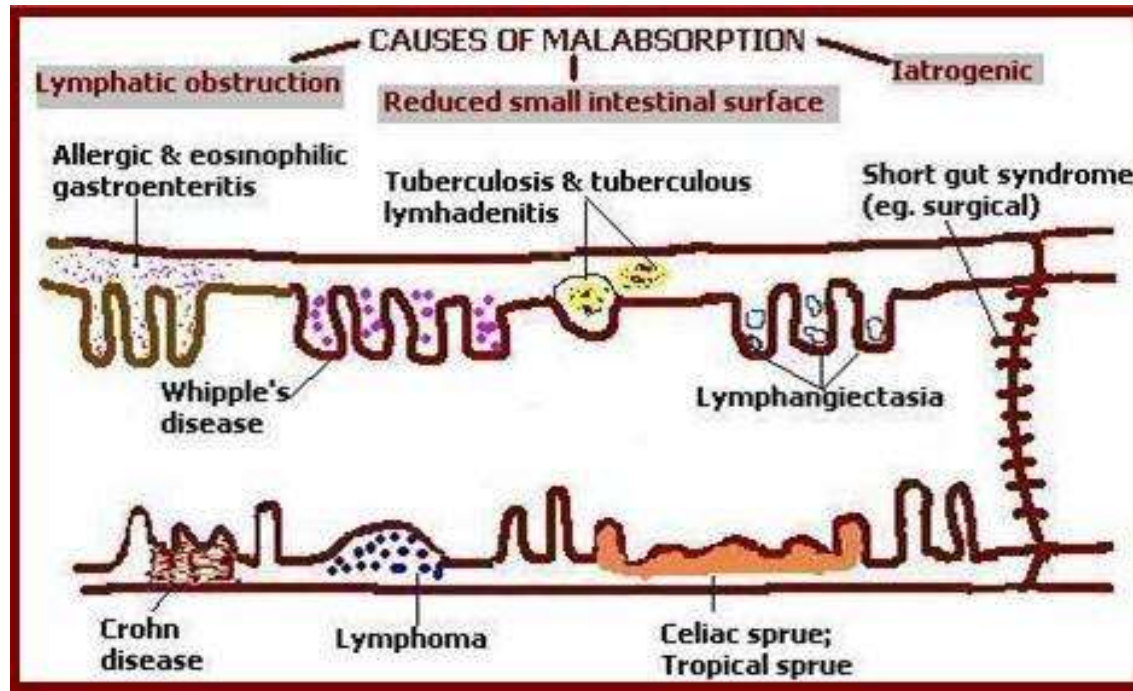
Malabsorption



Maldigestion/malabsorption: Blood tests

- Routine blood tests may reveal anaemia, high CRP or low albumin
- Microcytic anaemia usually implies iron deficiency and macrocytosis can be caused by impaired folic acid or B12 absorption or both
- Low cholesterol or triglyceride may give a clue toward fat malabsorption
- Low calcium and phosphate may give a clue toward osteomalacia from low vitamin D
- Specific vitamins like vitamin D or micro nutrient like zinc levels can be checked
- Fat soluble vitamins (A, D, E & K) are affected in fat malabsorption
- Prolonged prothrombin time can be caused by vitamin K deficiency
- IgA Anti-transglutaminase antibodies or IgA Anti-endomysial antibodies for Coeliac disease (gluten sensitive enteropathy)

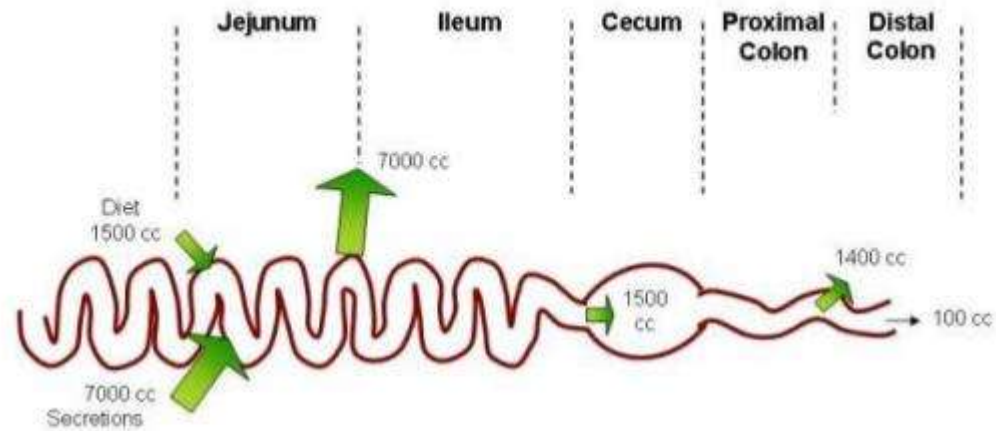
Fat malabsorption



Maldigestion/malabsorption: Stool studies

- Microscopy is particularly useful in diarrhoea, may show protozoa like Giardia, ova, cyst and other infective agents
- Fecal fat study to diagnose steatorrhoea is rarely performed nowadays
- Low fecal pancreatic elastase is indicative of pancreatic insufficiency
- Chymotrypsin and pancreolauryl can be assessed as well

Diarrhea and malabsorption



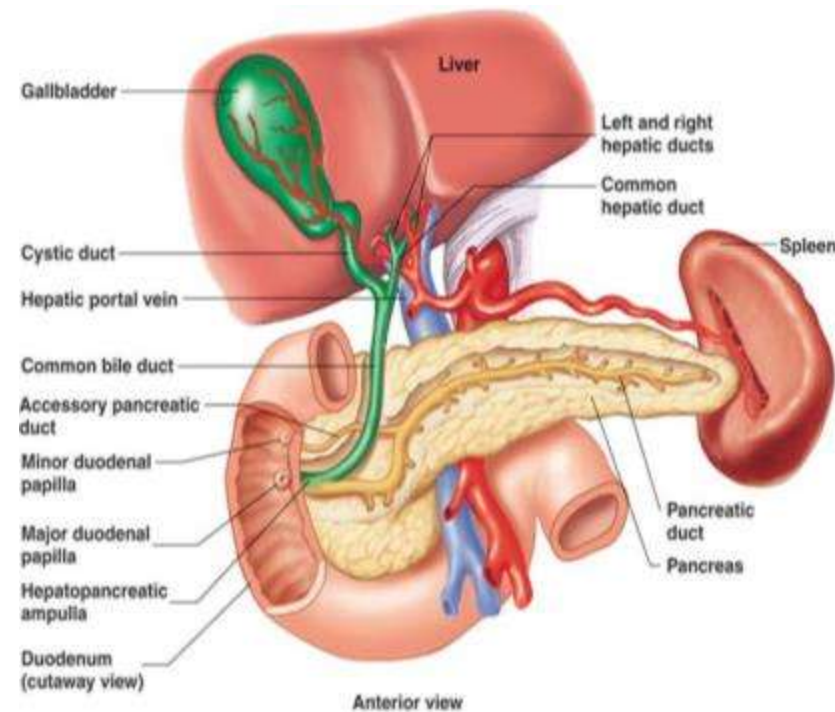
	Jejunum	Ileum	Cecum	Proximal Colon	Distal Colon
Mucosal Resistance	Leaky	Mod. Leaky	Mod. Tight	Tight	
Spontaneous P.D.	3 mV	6 mV	12 mV	20 mV	
Absorptive Mechanisms	Na-Nutrient Na-H	Na-Cl Na-Nutrient Na	Na SCFA	NaCl SCFA	Na

Lecture 14

Syndromes of Hepatobiliary Tract and Exocrine
Pancreas diseases

Plan of the lecture

- Definition of Hepatobiliary Tract and Exocrine Pancreas
- Spectrum of Hepatobiliary Tract and Pancreas Disorders
- Hepatobiliary Tract
 - Reminder (how does Hepatobiliary Tract work)
 - History-taking
 - Patient's examination (clinical, instrumental, laboratory)
 - syndromes
- Exocrine pancreas
 - Reminder (how does exocrine pancreas work)
 - History-taking
 - Patient's examination (clinical, laboratory, instrumental)
 - syndromes
- Glossary of terms referred to endocrine diseases and metabolic disorders



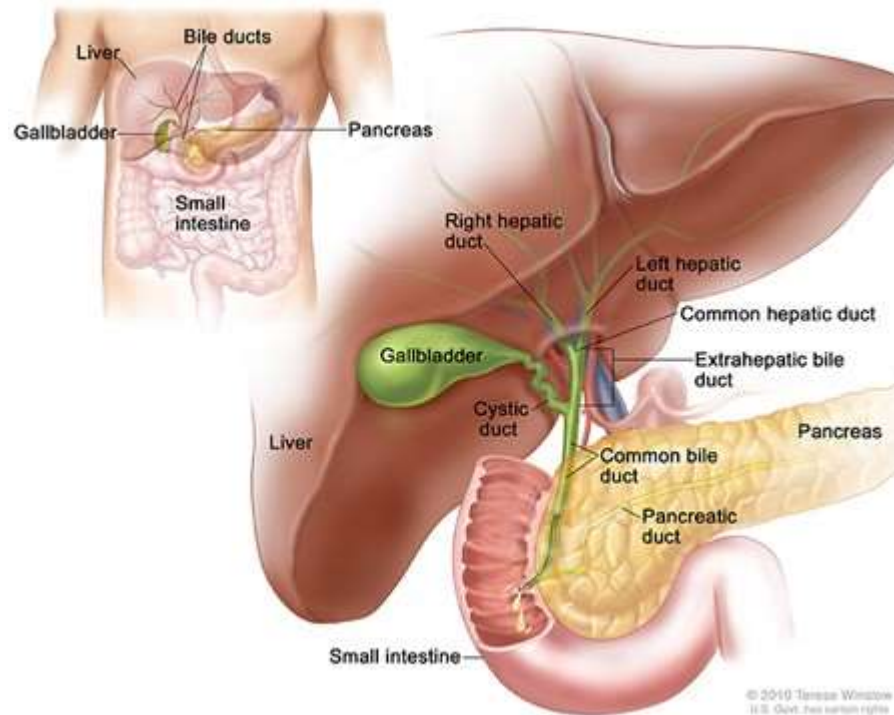
Definition of Hepatobiliary Tract and Exocrine Pancreas

- The hepatobiliary tract and exocrine pancreas is essential for digestion and includes: the liver, the pancreas, bile ducts and the gallbladder
 - The liver is one of the largest organs in the human body and has many functions including: processing food and changing it into energy; breaking down toxic substances in the body and their excretion; storing iron reserves, as well as vitamins and minerals; creating bile, which aids in digestion, glucose homeostasis, plasma protein synthesis, lipid and lipoprotein synthesis
 - The pancreas is an organ behind the stomach and in front of the spine, the primary exocrine function of the pancreas is to produce fluids to help break down food
 - After being produced by the liver, bile is secreted into the bile ducts and stored in the gallbladder; bile aids in the digestion of fats

Spectrum of Hepatobiliary Tract and Pancreas Disorders

- Liver
 - Liver Tumors
(hepatocellular carcinoma, metastatic colorectal cancer, neuroendocrine cancer, other metastatic tumor)
 - Benign Liver Lesions
(hepatic cyst, hemangioma, adenoma, focal nodular hyperplasia)
 - Hepatitis
 - Fatty liver
 - Liver Cirrhosis
- Pancreas
 - Pancreatic Cancer
 - Acute and Chronic Pancreatitis
 - Pseudocyst
 - Cystic Neoplasms
- Bile Ducts and Gallbladder
 - Gallstones
 - Stricture
 - Leaks (of bile, caused from trauma and surgery)
 - Gallbladder Cancer
 - Bile Duct Cancer
(cholangiocarcinoma)
 - Cholangitis
 - Cholecystitis

Hepatobiliary Tract: Reminder



[How does Hepatobiliary Tract work](#)

Hepatobiliary Tract: History-taking

Chief complaints' /signs “red flags”

- Pain
- Weight lost
- Fever
- Jaundice
- Acute diarrhea
- Persistent constipation
- Coagulopathy
- Bleeding
- Vomiting blood
- Hepatic encephalopathy
- Severe tenderness of the belly



Hepatobiliary Tract: History-taking

Example of specific questions in chief complaint

- Character
- Location
- Severity
- Timing
- Duration
- Radiation
- Provocation
- Relieving conditions
- When did it first start?
- How often does it occur?
- Is appetite good or has it changed?
- What brought it on?
- Were there associated symptoms
- Is it becoming more frequent with time?
- Are the symptoms lasting longer?
- How the symptoms relate to food intake?

Hepatobiliary Tract: Clinical examination of the patient

- General inspection from the end of the bed
- General examination of:
 - Hands/pulse
 - Face
 - Lymph nodes
- Examination of the abdomen
 - Inspection
 - Palpation
 - Percussion
 - Auscultation



Hepatobiliary Tract: Instrumental examination of the patient

- Flat-plate film of the abdomen
- Computed tomography
- Magnetic resonance imaging
- Abdominal ultrasonography
- Color Doppler
- Endoscopic ultrasonography
- Endoscopic retrograde cholangiopancreatography (ERCP)
- Biopsy



Hepatobiliary Tract: Laboratory examination of the patient

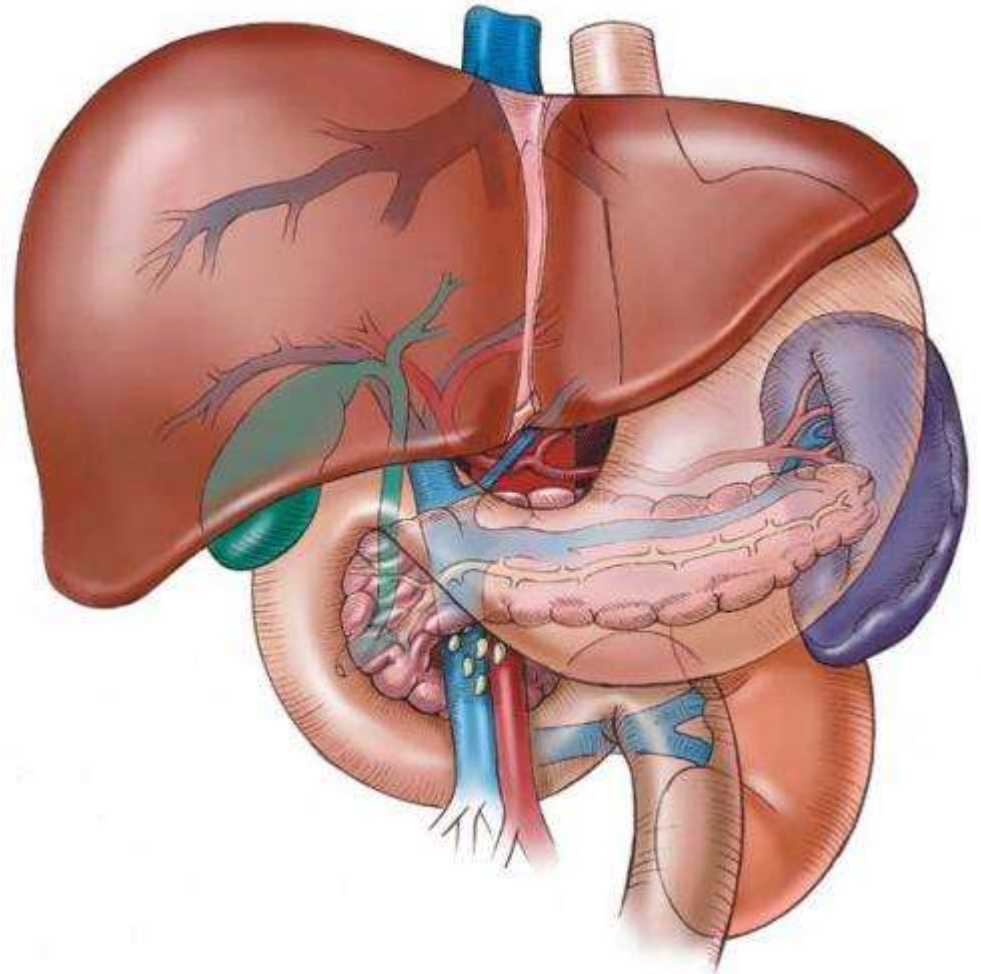
- Blood count
- Blood sugar tests
- Blood Coagulation
- Electrolytes
- Bilirubin blood test
- Plasma proteins
- Blood ammonia
- Alkaline phosphatase
- Gamma glutamyl transferase
- Enzyme & protein blood tests
- Lipid blood tests
- C-reactive protein
- Fecal occult blood test
- Serology (viral hepatitis)



Photo courtesy of Cepheid

Hepatobiliary Tract: syndromes

- Gallbladder motility disorder
- Jaundice
- The syndromes of liver size changes
- Portal hypertension
- Hepatocellular Dysfunction
- Cholestatic syndrome



Gallbladder motility disorder: Definition

- Gallbladder motility disorder is defined as biliary pain in the absence of gallstones, sludge, microlithiasis, or microcrystal disease
- The diagnosis is considered in patients with typical biliary-type pain who have had other causes for the pain excluded
- The prevalence of functional gallbladder disorder among patients with biliary-type pain and a normal transabdominal gallbladder ultrasound is up to 8 percent in men and 21 percent in women

Gallbladder motility disorder: Cause and mechanisms

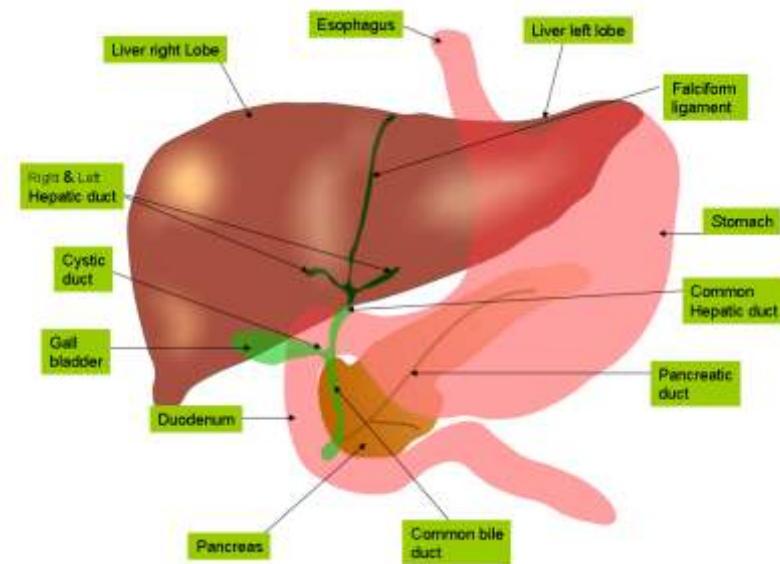
- The cause is unclear, but it is generally regarded as a motility disorder of the gallbladder
- It may result from an initial metabolic disorder (i.e., bile supersaturated with cholesterol) or a primary motility disorder in the absence, at least initially, of any abnormalities of bile composition
- It has been noted that patients with functional gallbladder disorder may have abnormal gastric emptying and colonic transit, suggesting a possible generalized gastrointestinal motility disorder
- The hypothesis that disorder is related to abnormal gallbladder motility is the basis for measuring the gallbladder ejection fraction as part of the evaluation

Gallbladder motility disorder: Clinical signs

- Patients present with biliary-type pain, also known as biliary colic
- The liver and pancreas blood tests are normal, no gallstones or gallbladder sludge are seen on imaging, and upper endoscopic examinations are normal
- Despite the name, biliary colic is usually constant and not colicky
- The classic description is of an intense discomfort located in the right upper quadrant or epigastrium that may radiate to the back (particularly the right shoulder blade)
- The pain is often associated with diaphoresis, nausea, and vomiting
- The pain plateaus in less than an hour, ranging from moderate to excruciating in severity
- Once it has plateaued, the pain typically lasts at least 30 minutes and then slowly subsides over several hours, with the entire attack usually lasting less than six hours
- While the pain often develops one to two hours after ingestion of a fatty meal, an association with meals is not universal, and in a significant proportion of patients the pain is nocturnal, with a peak occurrence around midnight
- While nonspecific dyspeptic symptoms, such as indigestion, abdominal bloating, and belching, may coexist in patients with biliary colic, they are not usually relieved by cholecystectomy

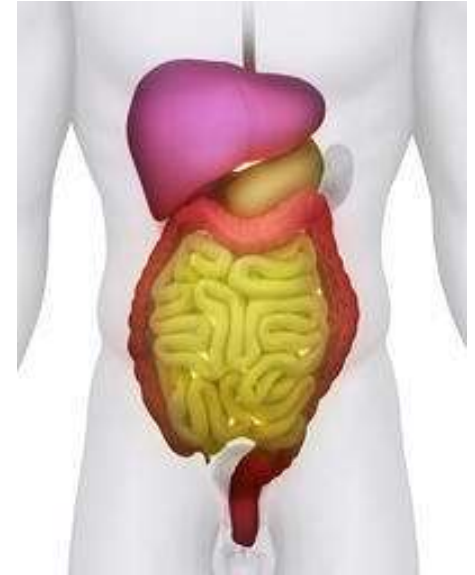
Gallbladder motility disorder: Laboratory, imaging, and endoscopic studies

- ❖ Patients with functional gallbladder disorder have normal blood tests, including aminotransferases, bilirubin, alkaline phosphatase/gamma-glutamyltranspeptidase, amylase, and lipase
- In addition, abdominal imaging is normal, with no evidence of gallstones, gallbladder sludge, or cholesterol polyps
- Finally, patients have normal upper endoscopic examinations



Gallbladder motility disorder: The Rome III criteria for biliary-type pain

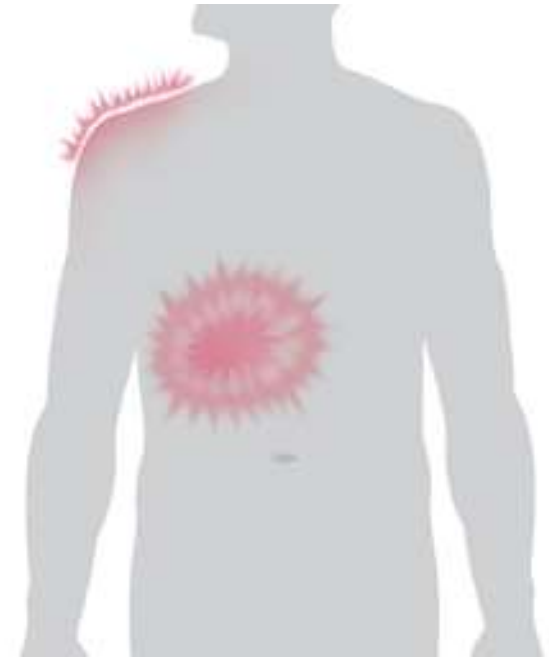
- Pain is located in the epigastrium and/or right upper quadrant
- Pain is recurrent, but occurs at variable intervals (not daily)
- Pain lasts at least 30 minutes
- Pain builds up to a steady level
- Pain is severe enough to interrupt daily activities or lead to an emergency department visit
- Pain is not relieved by bowel movements, postural changes, or antacids



Gallbladder motility disorder: The Rome III criteria for biliary-type pain

Supportive criteria

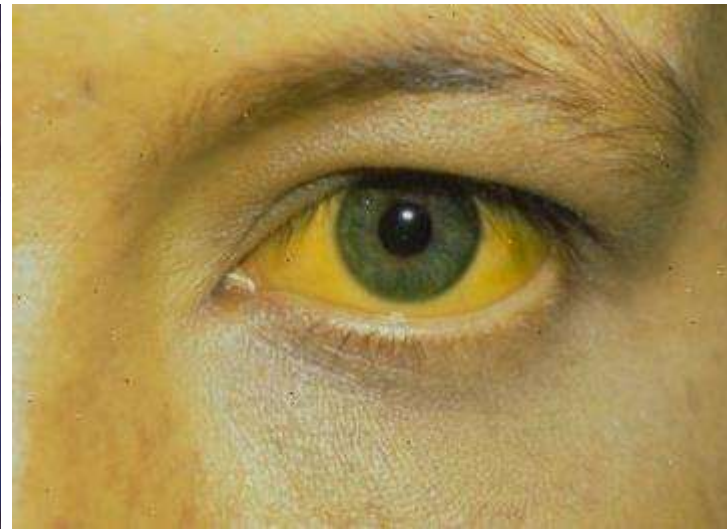
- Pain is associated with nausea and vomiting
- Pain radiates to the back and/or right infrascapular region
- Pain awakens the patient from sleep in the middle of the night



Jaundice: Definition

- Jaundice (icterus) is a yellowish pigmentation of the skin, the conjunctival membranes over the sclerae (whites of the eyes), and other mucous membranes caused by high blood bilirubin levels
- This hyperbilirubinemia subsequently causes increased levels of bilirubin in the extracellular fluid
- Concentration of bilirubin in blood plasma is normally below 1.2 mg/dL ($<25\mu\text{mol/L}$)
- A concentration higher than approx. 3 mg/dL ($>50\mu\text{mol/L}$) leads to jaundice

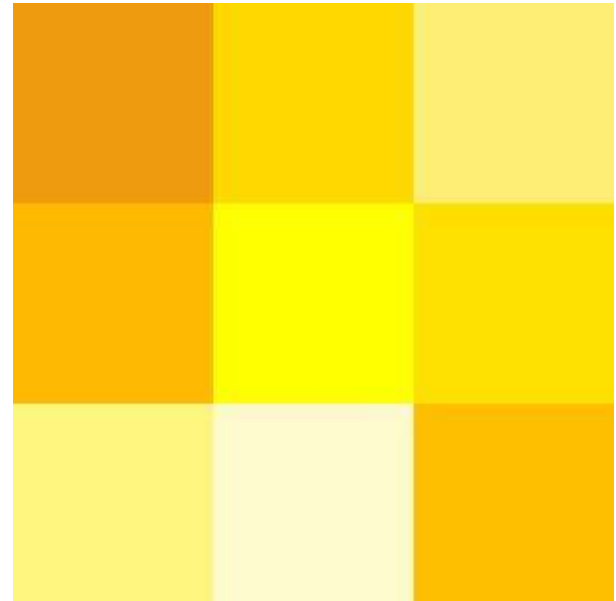
Jaundice



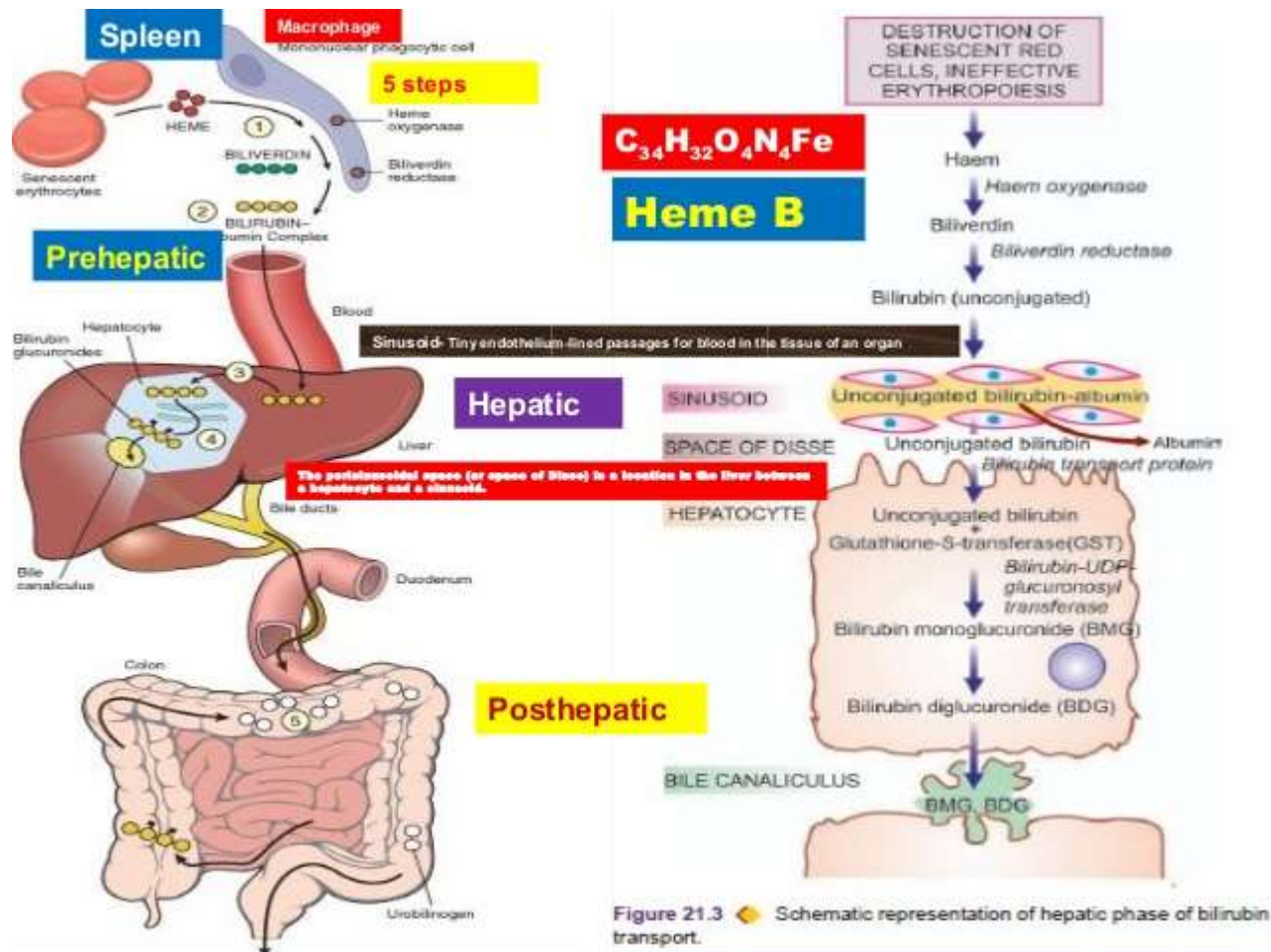
-
- A concentration higher than approx. 3 mg/dL ($>50\mu\text{mol/L}$) leads to jaundice

Jaundice: Types

- Pre-hepatic jaundice
- Intra-hepatic jaundice
- Post-hepatic jaundice
- Neonatal jaundice



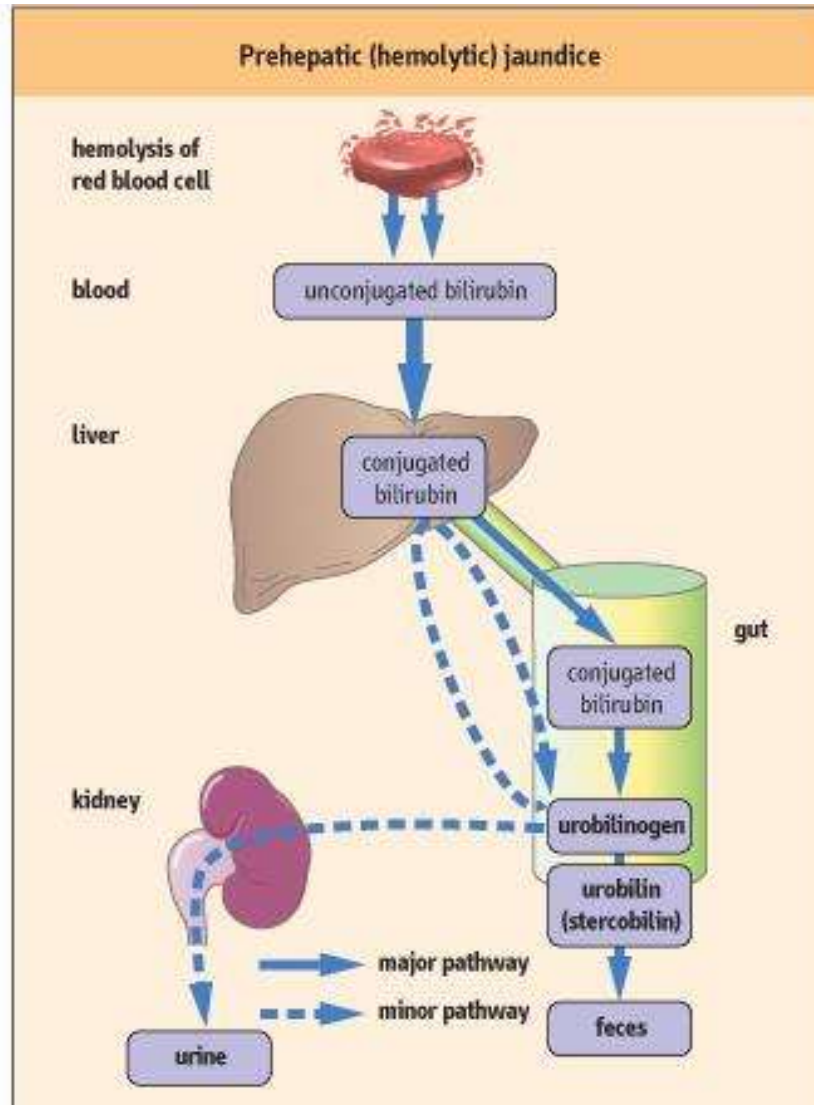
Jaundice



Jaundice: Pre-hepatic jaundice

- Pre-hepatic jaundice is caused by anything which causes an increased rate of hemolysis (breakdown of red blood cells): severe malaria, sickle cell anemia, spherocytosis, thalassemia, pyruvate kinase deficiency, glucose 6-phosphate dehydrogenase deficiency, diseases of the kidney, defects in bilirubin metabolism etc.
- The increased breakdown of red blood cells leads to an increase in the amount of unconjugated bilirubin present in the blood and deposition of this unconjugated bilirubin into various tissues can lead to a jaundiced appearance
- In jaundice secondary to hemolysis, the increased production of bilirubin leads to the increased production of urine-urobilinogen
- Bilirubin is not usually found in the urine because unconjugated bilirubin is not water-soluble, so, the combination of increased urine-urobilinogen with no bilirubin (since, unconjugated) in urine is suggestive of hemolytic jaundice

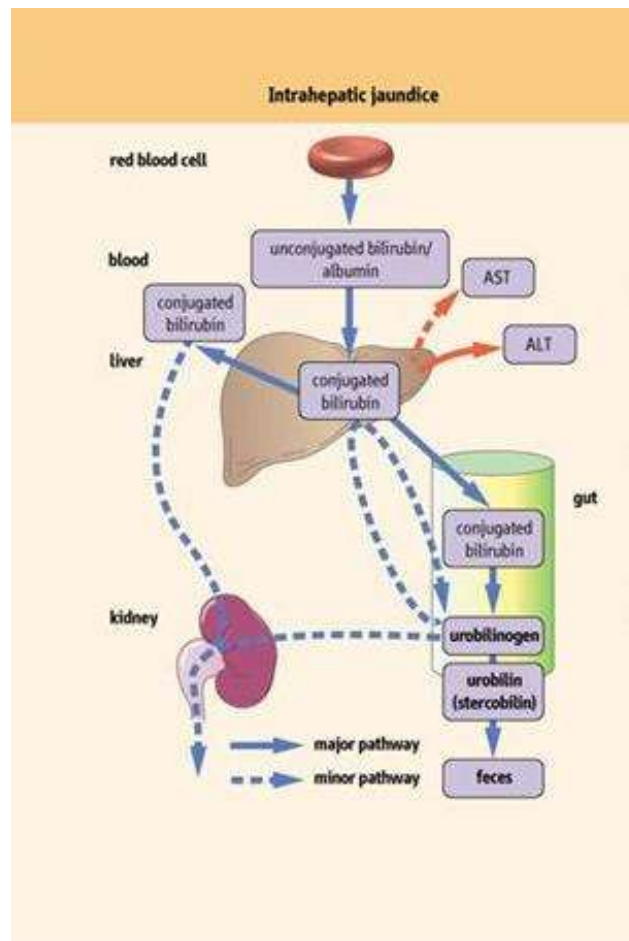
Jaundice



Jaundice: Intra-hepatic jaundice

- Intra-hepatic jaundice can be caused by acute or chronic hepatitis, hepatotoxicity, cirrhosis, drug-induced hepatitis and alcoholic liver disease
- Cell necrosis reduces the liver's ability to metabolize and excrete bilirubin leading to a buildup of unconjugated bilirubin in the blood
- Other causes include primary biliary cirrhosis leading to an increase in plasma conjugated bilirubin because there is impairment of excretion of conjugated bilirubin into the bile
- The blood contains an abnormally raised amount of conjugated bilirubin and bile salts which are excreted in the urine
- The unconjugated bilirubin still enters the liver cells and becomes conjugated in the usual way
- This conjugated bilirubin is then returned to the blood, probably by rupture of the congested bile canaliculi and direct emptying of the bile into the lymph leaving the liver
- Thus, most of the bilirubin in the plasma becomes the conjugated type rather than the unconjugated type, and this conjugated bilirubin which did not go to intestine to become urobilinogen gives the urine the dark color

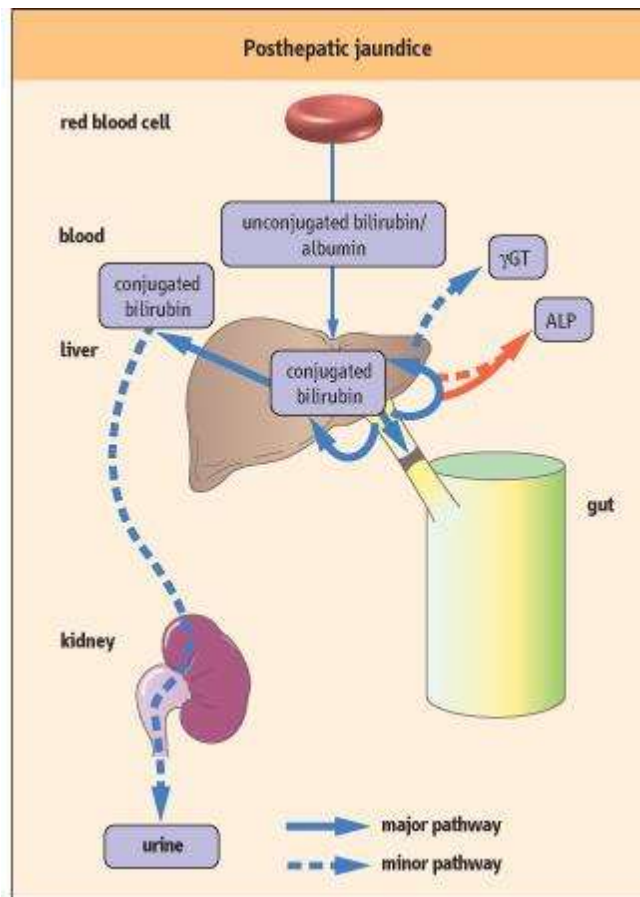
Jaundice



Jaundice: Post-hepatic jaundice

- Post-hepatic (obstructive) jaundice, is caused by an interruption to the drainage of bile containing conjugated bilirubin in the biliary system
- The most common causes are gallstones in the common bile duct, and pancreatic cancer in the head of the pancreas
- Also, a group of parasites known as "liver flukes" can live in the common bile duct, causing obstructive jaundice
- Other causes include strictures of the common bile duct, biliary atresia, cholangiocarcinoma, pancreatitis, cholestasis of pregnancy, and pancreatic pseudocysts
- In complete obstruction of the bile duct, no urobilinogen is found in the urine, since bilirubin has no access to the intestine and it is in the intestine that bilirubin gets converted to urobilinogen to be later released into the general circulation
- Presence of bilirubin (conjugated) in the urine without urine-urobilinogen suggests obstructive jaundice, either intra-hepatic or post-hepatic
- The presence of pale stools and dark urine suggests an obstructive or post-hepatic cause as normal feces get their color from bile pigments
- Patients also can present with elevated serum cholesterol, and often complain of severe itching or "pruritus" because of the deposition of bile salt

Jaundice



Jaundice: Neonatal jaundice

- Neonatal jaundice is usually harmless and is often seen in infants around the second day after birth, lasting until day 8 in normal births, or to around day 14 in premature births
- Typical causes for neonatal jaundice include normal physiologic jaundice, jaundice due to formula supplementation and hemolytic disorders that include hereditary spherocytosis, glucose-6-phosphate dehydrogenase deficiency, pyruvate kinase deficiency, ABO/Rh blood type autoantibodies, or infantile pyknocytosis
- Serum bilirubin normally drops to a low level without any intervention required
- In cases where bilirubin rises higher, a brain-damaging condition known as kernicterus can occur, leading to significant disability
- A Bili light is often the tool used for early treatment, which often consists of exposing the baby to intensive phototherapy

Jaundice



Jaundice: Symptoms

- The main symptom of jaundice is a yellowish discoloration of the white area of the eye and the skin
- The conjunctiva of the eye are one of the first tissues to change color as bilirubin levels rise in jaundice
- Urine is dark in colour
- Stools (faeces or poo) can be pale in colour

Jaundice

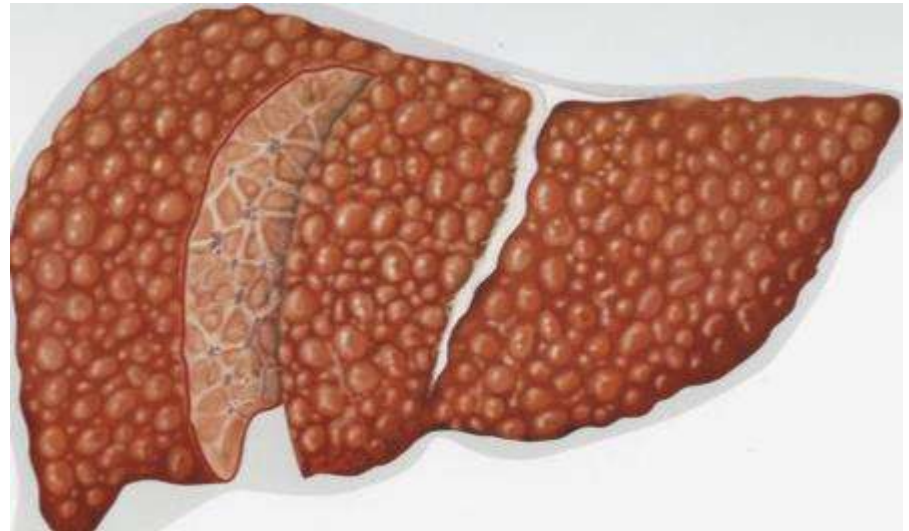


Jaundice: Diagnostic tests

Function test	Jaundice		
	Pre-hepatic	Hepatic	Post-hepatic
Total bilirubin	Normal / Increased	Increased	
Conjugated bilirubin	Normal	Increased	Increased
Unconjugated bilirubin	Normal / Increased	Increased	Normal
Urobilinogen	Normal / Increased	Decreased	Decreased / Negative
Urine Color	Normal	Dark (urobilinogen + conjugated bilirubin)	Dark (conjugated bilirubin)
Stool color	Normal	Normal/Pale	Pale
Alkaline phosphatase levels	Normal	Increased	
Alanine transferase and aspartate transferase levels		Increased	
Conjugated Bilirubin in Urine	Not Present	Present	
Splenomegaly	Present	Present	Absent

The syndromes of liver size changes

- Enlarged Liver (Hepatomegaly)
- Small for size syndrome



Bridging Fibrosis

Enlarged Liver: Causes

- Alcoholic liver disease
- Congestive heart failure
- Cirrhosis
- Hepatitis
- Liver cancer
- Hyperlipidemias
- Chronic leukocytic leukemia
- Hepatic vein thrombosis (Budd-Chiari syndrome)
- Metabolic syndrome X
- Pericarditis
- Adult-Onset Still's disease
- Hypolipoproteinemia

Enlarged Liver: Symptoms

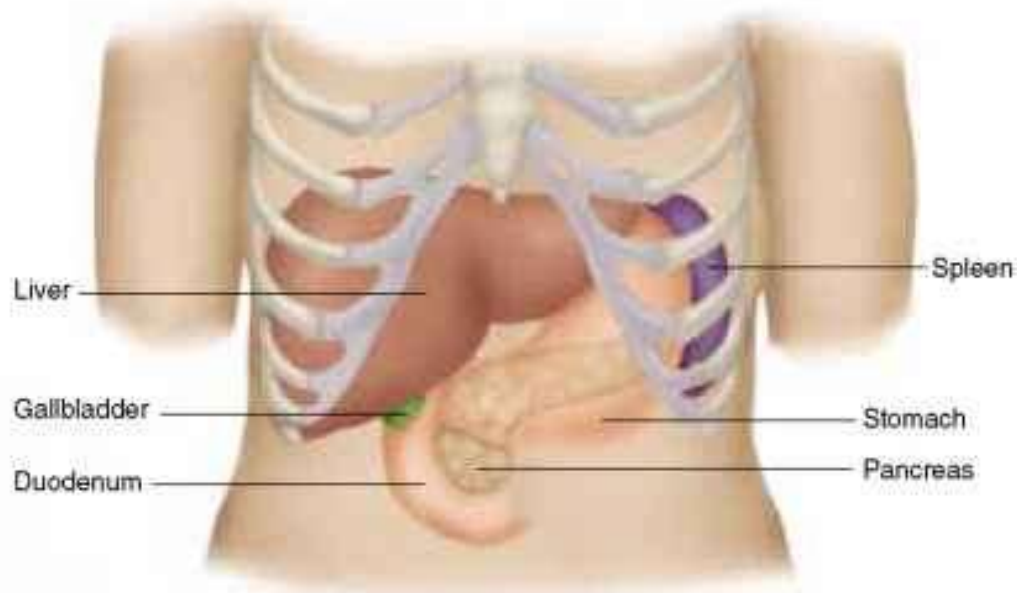
- A feeling of fullness
- Discomfort in the belly
- Depending on the cause of enlarged liver, patient may notice symptoms like:
 - Jaundice
 - Fatigue and weakness
 - Nausea
 - Weight loss

Enlarged Liver: Diagnosis

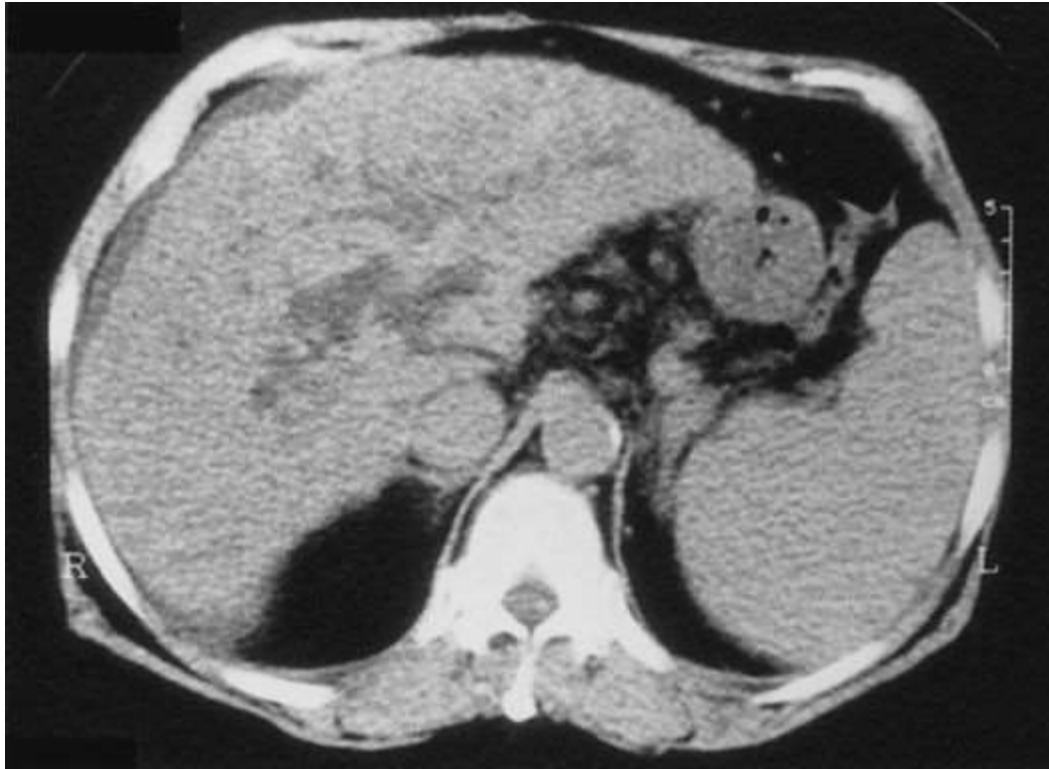
- Physical examination
- CT scan
- MRI
- Ultrasound



Enlarged Liver: Physical examination



Enlarged Liver: CT scan



Native CT scan shows a slightly lobulated liver contour with ascites and dilated bile ducts and an enlarged spleen

Enlarged Liver: MRI



Hepatomegaly and multiple hypoechoic areas in spleen suggesting splenic involvement

Enlarged Liver: Ultrasound

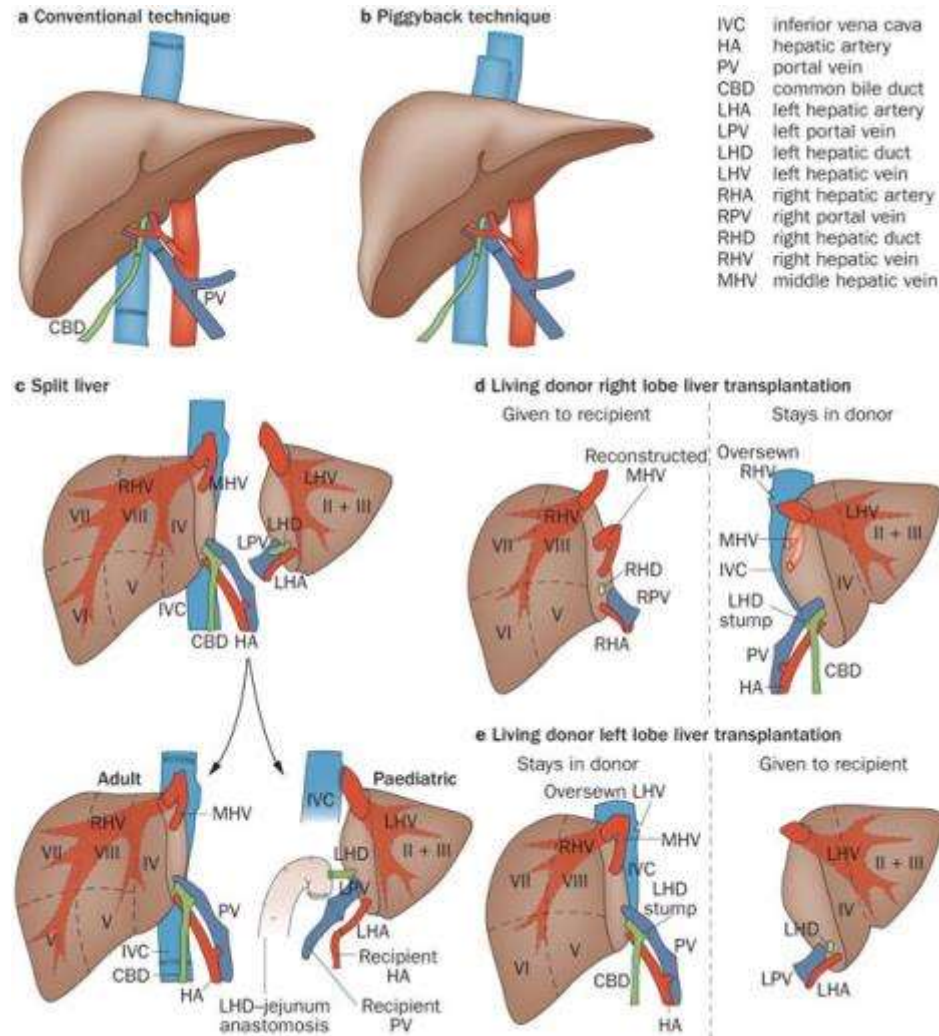


Hodgkin disease with splenomegaly hepatomegaly
and enlarged mesenteric lymph nodes

Small for size syndrome: Causes

- Small for size syndrome - is a condition which causes considerable confusion partly because the term has been extended beyond its original meaning
 - It was initially used to describe the situation in liver transplantation where a patient develops liver dysfunction and ascites because the donated organ is too small for the recipient
 - It is now used variably to describe any circumstance where there is post operative liver failure or dysfunction in a patient who has had liver resection or partial or small graft liver transplantation

Small for size syndrome: Liver transplantation



Small for size syndrome: Mechanisms

- Small-for-size syndrome can occur in the special situation of partial liver graft transplantation, especially in adult living donor liver transplantation, with resultant size mismatching between graft size and recipient hepato-portal circulation
- Once the partial liver volume graft is subjected to excessive portal inflow, portal hyperperfusion results in the development of the small-for-size syndrome

Small for size syndrome: Symptoms

- Excessive ascites
- Hyperbilirubinemia
- Coagulopathy
- Encephalopathy
- Renal dysfunction

Transplant recipients develop symptoms related to the above abnormalities after transplantation and post-transplant prognosis is reported to be less than ideal

Portal hypertension: Definition

- Portal hypertension is abnormally high blood pressure in the portal vein system, which is composed of the portal vein, and its branches and tributaries
- Portal hypertension is defined as elevation of hepatic venous pressure gradient to $>5\text{mmHg}$

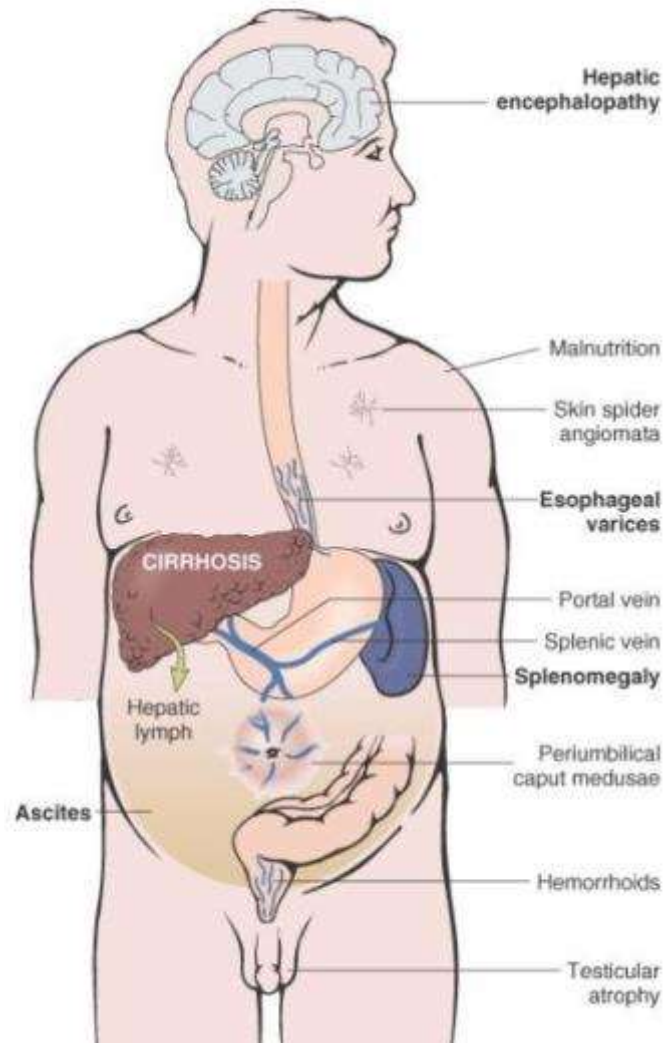
Portal hypertension: Causes

- Prehepatic: portal vein thrombosis or congenital atresia
- Intrahepatic: liver cirrhosis, hepatic fibrosis, noncirrhotic causes (schistosomiasis, massive fatty change and diffuse granulomatous diseases)
- Posthepatic: hepatic vein thrombosis, inferior vena cava thrombosis, inferior vena cava congenital malformation, constrictive_pericarditis

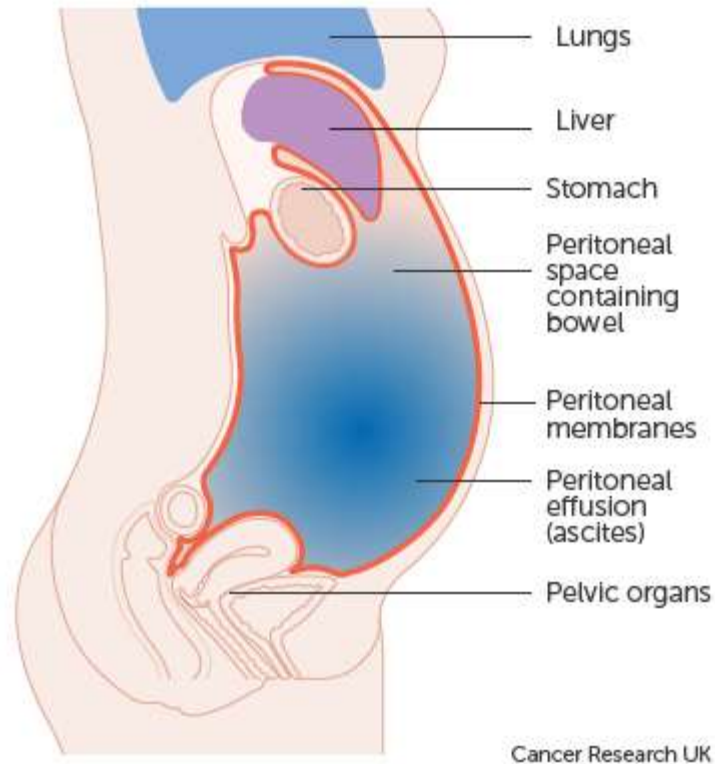
Portal hypertension: Symptoms

- Weakness, tiredness, and malaise
- Anorexia, weight loss (common with acute and chronic liver disease)
- Ascites
- Hepatic encephalopathy
- Increased risk of spontaneous bacterial peritonitis
- Increased risk of hepatorenal syndrome
- Splenomegaly with a consequent accumulation of red blood cells, white blood cells, and platelets, together leading to mild pancytopenia
- Development of varices at portacaval anastomoses: esophageal varices, gastric varices, anorectal varices, caput medusae
- Esophageal and gastric varices pose an ongoing risk of life-threatening bleeding, with bloody vomiting or melena

Portal hypertension: Symptoms



Portal hypertension: Ascites



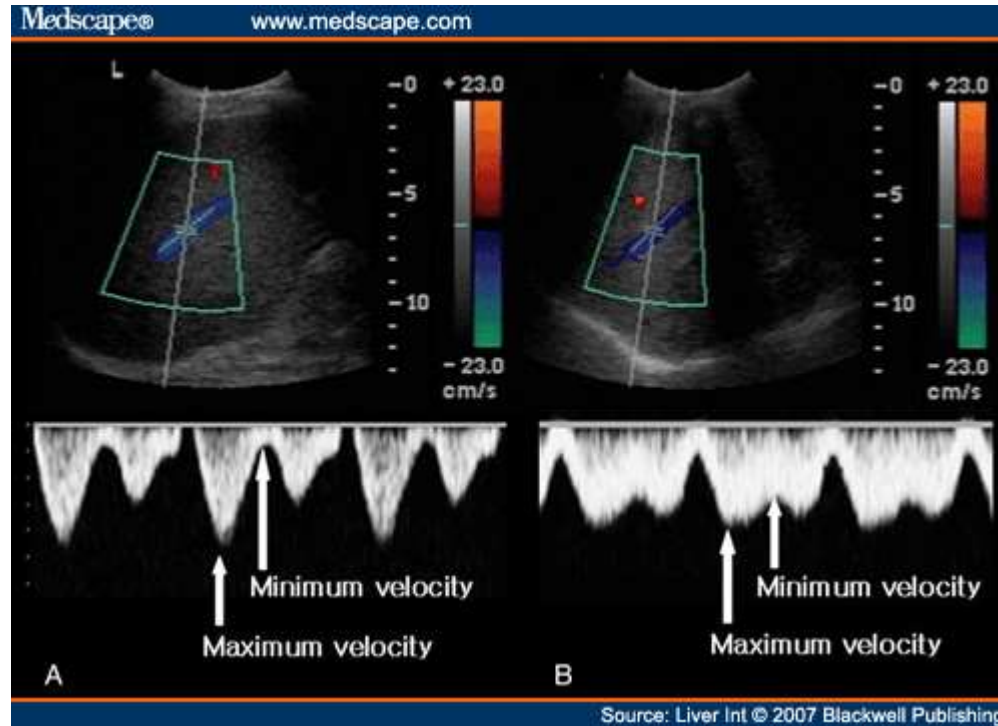
Portal hypertension: Caput medusae



Portal hypertension: Diagnosis

- Clinical symptoms
- HVPG (hepatic venous pressure gradient) measurement as the gold standard for assessing the severity of portal hypertension
- HVPG replaced the old one - contrast angiography
- Portal hypertension is defined as HVPG greater than or equal to 5mm Hg and is considered to be clinically significant when HVPG exceeds 10 to 12 mm Hg
- Imaging tests, such as duplex Doppler ultrasonography , magnetic resonance imaging (MRI), or computed tomography (CT)
- Liver biopsy and histologic examination
- Hemodynamic measurement of the hepatic venous pressure gradient (HVPG): A criterion standard for assessment of portal hypertension
- Upper GI endoscopy (or, esophagogastroduodenoscopy [EGD]): A criterion standard for assessment of portal hypertension

Portal hypertension: Hepatic venous pressure gradient



Measurement of damping index (DI) of hepatic vein waveform. DI is calculated by the minimum velocity/maximum velocity of the downward hepatic vein wave.

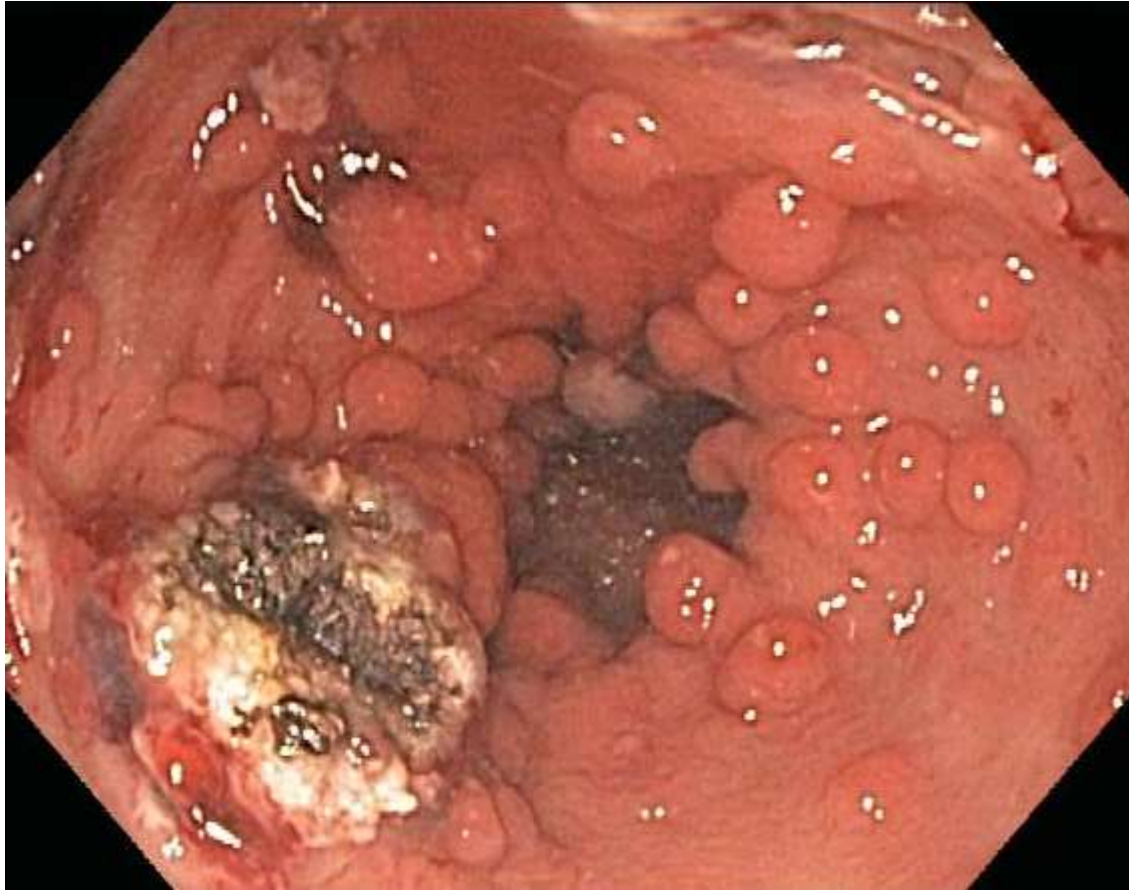
(A) A patient with liver cirrhosis showed 0.26 of DI with 7 mmHg of hepatic venous pressure gradient (HVPg). (B) Another patient with liver cirrhosis showed 0.72 of DI with 15 mmHg of HVPg.

Portal hypertension: MRI



Coronal section plane of the abdomen acquired with the true fast imaging (TRUFI) sequence, used to define the middle segment of the portal vein.

Portal hypertension: Esophagogastroduodenoscopy

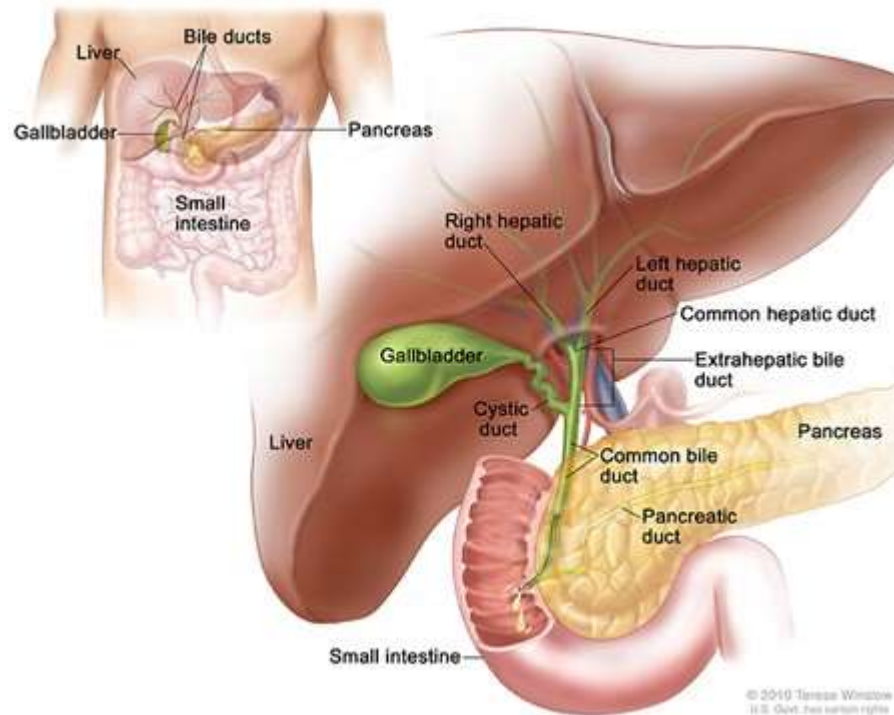


Endoscopic view of multiple, large portal hypertensive polyps in the antrum.

Portal hypertension: Laboratory testing

- Complete blood count
- Liver function tests (e.g., aspartate aminotransferase [AST], alanine aminotransferase [ALT], bilirubin, alkaline phosphatase [ALP])
- Coagulation studies (prothrombin time [PT], partial thromboplastin time [PTT], international normalized ratio [INR])
- Blood urea nitrogen, creatinine, and electrolytes
- Arterial blood gas (ABG) and pH measurements
- Hepatic and viral hepatitis serology, particularly hepatitis B and C serology
- Albumin levels: Hypoalbuminemia is common (impaired hepatic synthetic function)
- Antinuclear antibody, antimitochondrial antibody, antismooth muscle antibody
- Iron indices
- Alpha1-antitrypsin deficiency
- Ceruloplasmin, 24-hour urinary copper

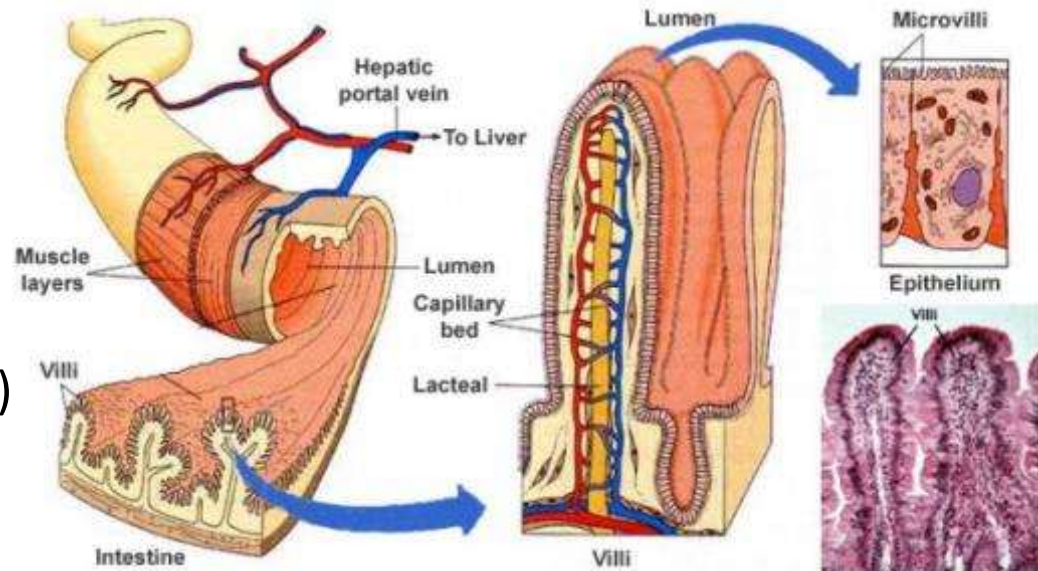
Exocrine pancreas: Reminder



[How do Exocrine Pancreas works](#)

Exocrine pancreas: History-taking

- Upper abdominal pain
- Nausea and vomiting
- Malabsorption
- Diabetes
- Losing weight without trying
- Oily, smelly stools (steatorrhea)
- Tenderness when touching the abdomen
- Miscellaneous



Exocrine pancreas: History-taking

Example of specific questions in chief complaint

- Character
- Location
- Severity
- Timing
- Duration
- Radiation
- Provocation
- Relieving conditions
- When did it first start?
- How often does it occur?
- Is appetite good or has it changed?
- What brought it on?
- Were there associated symptoms
- Is it becoming more frequent with time?
- Are the symptoms lasting longer?
- How are the symptoms related to food intake?

Exocrine pancreas: Clinical examination of the patient

- General inspection from the end of the bed
- General examination of:
 - Hands/pulse
 - Face
 - Lymph nodes
- Examination of the abdomen
 - Inspection
 - Palpation
 - Percussion
 - Auscultation



Exocrine pancreas: Instrumental examination of the patient

- Flat-plate film of the abdomen
- Computed tomography
- Magnetic resonance imaging
- Abdominal ultrasonography
- Color Doppler
- Endoscopic ultrasonography
- Endoscopic retrograde cholangiopancreatography (ERCP)



Exocrine pancreas: Laboratory examination of the patient

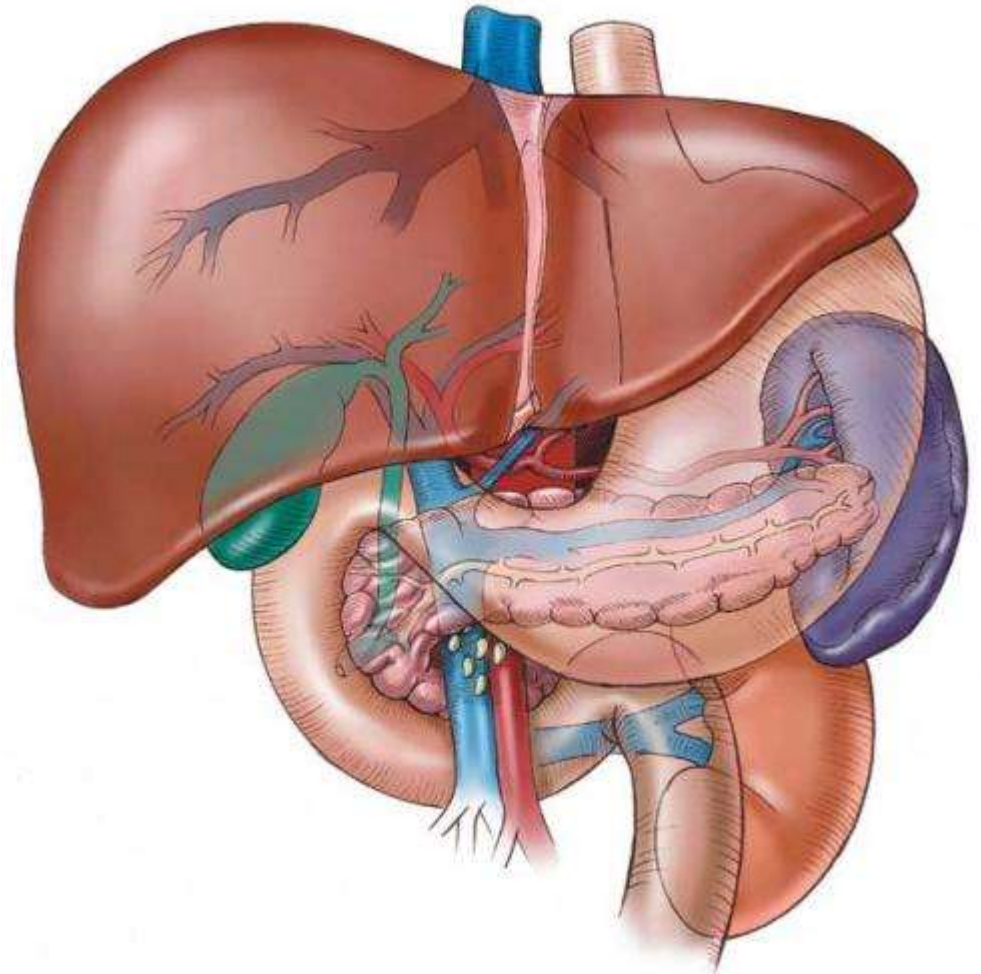
- Blood count
- Blood sugar tests
- Blood Coagulation
- Electrolytes
- Bilirubin blood test
- Plasma proteins
- Blood ammonia
- Alkaline phosphatase
- Gamma glutamyl transferase
- Enzyme & protein blood tests
- Lipid blood tests
- C-reactive protein
- Fecal occult blood test



Photo courtesy of Cepheid

Exocrine pancreas: Syndromes

- Exocrine Pancreatic Insufficiency
 - Diarrhea
 - Steatorrhea
 - Abdominal pain
 - Symptoms of vitamin deficiencies



Exocrine Pancreatic Insufficiency: Definition

- Exocrine pancreatic insufficiency (EPI) is the inability to properly digest food due to a lack of digestive enzymes made by the pancreas
- EPI is caused by a progressive loss of the pancreatic cells that make digestive enzymes

Exocrine Pancreatic Insufficiency: Causes

- Pancreatic
 - Chronic pancreatitis
 - Cystic fibrosis
 - Obstructions of the pancreatic duct (e.g., from pancreatic cancer or ampullary tumors)
 - Shwachman-Diamond syndrome (EPI, bone marrow dysfunction, leukemia predisposition, and skeletal abnormalities)
- Nonpancreatic
 - Celiac disease
 - Crohn disease
 - Autoimmune pancreatitis
 - Zollinger-Ellison syndrome
 - GI and pancreatic surgical procedures

Exocrine Pancreatic Insufficiency: Pathophysiology

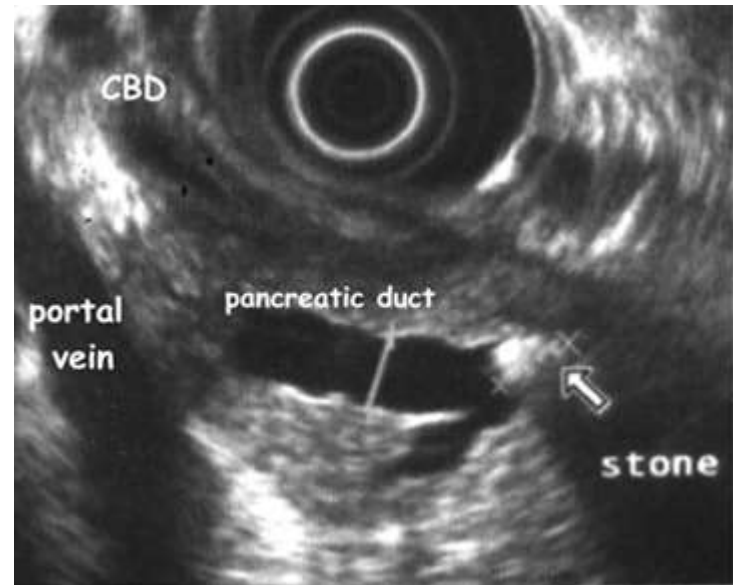
- EPI is characterized by a deficiency of exocrine pancreatic enzymes, which results in inability to digest food properly (i.e., maldigestion)
- Because pancreatic lipase accounts for up to 90% of fat digestion, maldigestion of fat is more profound in EPI than maldigestion of proteins and carbohydrates is
- Because the exocrine pancreas retains a large reserve capacity for enzyme secretion, fat digestion is not clearly impaired until lipase output decreases to below 10% of the normal level
- Fat malabsorption precedes malabsorption of other macronutrients
- Bile salt precipitation and subsequent adsorption to undigested food reduces the bile salt pool, and this reduction further impairs fat digestion
- Undigested fat, rather than being absorbed, is excreted in the feces, leading to steatorrhea
- Another factor that contributes to pancreatic steatorrhea is the presence of neurohormonal disturbances, which result in gall bladder hypomotility and accelerated gastric and intestinal transit
- Malabsorption of fat-soluble vitamins A, D, E, and K may accompany EPI

Exocrine Pancreatic Insufficiency: Symptoms

- Steatorrhea
- Weight loss
- Diarrhea
- Pale, bulky, malodorous stools often float on top of the toilet water with oily droplets and are difficult to flush
- Fatigue
- Flatulence and abdominal distention
- Edema (result from hypoalbuminemia)
- Anemia (can be either microcytic (related to iron deficiency) or macrocytic (related to vitamin B-12 deficiency))
- Bleeding disorders (a consequence of vitamin K malabsorption and subsequent hypoprothrombinemia)
- Ecchymosis
- Metabolic bone disease (vitamin D deficiency)
- Neurologic manifestations (result from electrolyte disturbances): generalized motor weakness, peripheral neuropathy, loss of a sense of vibration and position, night blindness, seizures

Exocrine Pancreatic Insufficiency: Diagnosis

- Blood tests
- 3-day fecal test
- Fecal elastase-1
- CT scan
- MRI
- Endoscopic ultrasound



Exocrine Pancreatic Insufficiency: 3-day fecal test

- The normal range for fecal fat testing is 7 grams over a 24-hour period
- Normal results for a 72-hour test would be 21 grams



Fecal Stool Test Kits

Exocrine Pancreatic Insufficiency: Fecal elastase-1

Reference concentration to interpret
Pancreatic Elastase results for adults and
children after the first month of life:

- Values $> 200 \mu\text{g}$ elastase/g stool indicate normal exocrine pancreatic function
- Values of $100\text{-}200 \mu\text{g}$ elastase/g stool suggest mild to moderate pancreatic insufficiency
- Values $< 100 \mu\text{g}$ elastase/g stool indicate exocrine pancreatic insufficiency



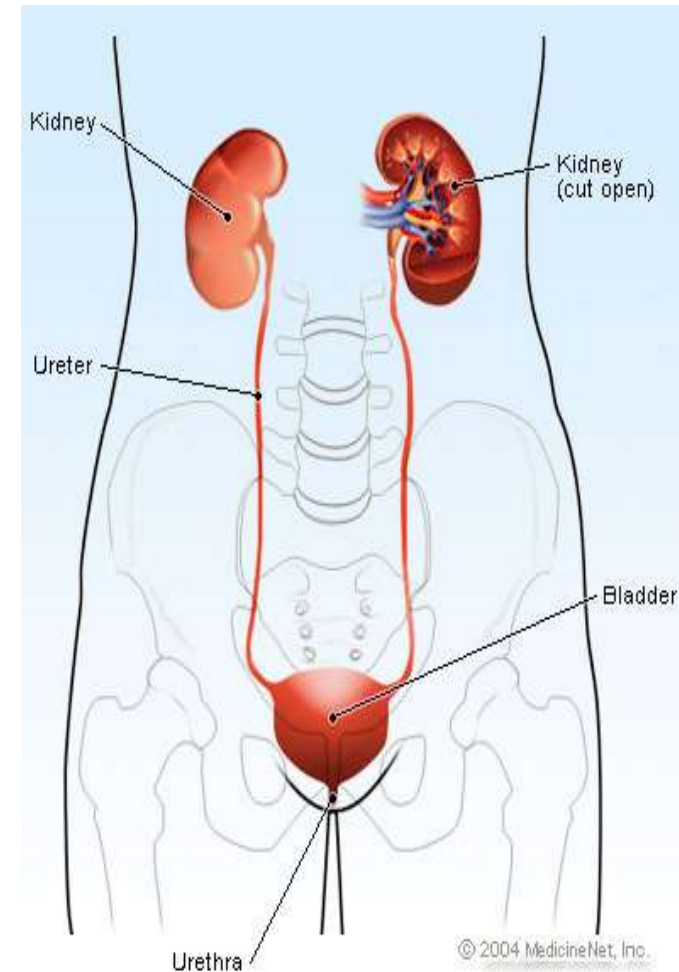
Extraction Buffer for Fecal
Elastase 1™ Kit

Lecture 15

Syndromes of kidneys diseases

Plan of the lecture

- The importance(value) of a human kidney
- Reminder
 - how do kidneys work
 - the primary function
 - purpose
- History-taking
- Patient's examination
 - clinical
 - laboratory
 - instrumental
- Spectrum of urinary system diseases
- Urinary system diseases' symptoms and syndromes
 - symptoms
 - urinary syndrome
 - nephrotic syndrome
 - nephritic syndrome
 - urinary tract obstruction syndrome
 - hypertensive syndrome
- Glossary of urinary pathology' terms



The price of a human kidney

The human kidney is the body's filter. It cleans 180 liters of liquid per day, retaining the good stuff and expelling the bad. Most fortuitously, humans are born with two kidneys. If one of them becomes damaged, the other one can pick up the slack. If both your kidneys fail, however, your body will be filled with harmful toxins. Without medical intervention, **such patients** will die within several weeks



Reminder: how kidneys work



<https://www.youtube.com/watch?v=aj-gbnOB4jM>

Reminder: the primary urinary system functions

- maintain homeostasis
- regulate fluids and electrolytes
- eliminate waste products
- maintain blood pressure (BP)
- involved with red blood cell (RBC) production
- involved with bone metabolism

Reminder: purpose

- General evaluation of health
- Diagnosis of disease or disorders of the kidneys or urinary tract
- Diagnosis of other systemic diseases that affect kidney function
- Monitoring of patients with diabetes
- Screening for drug toxicity (eg. sulfonamide or aminoglycosides)

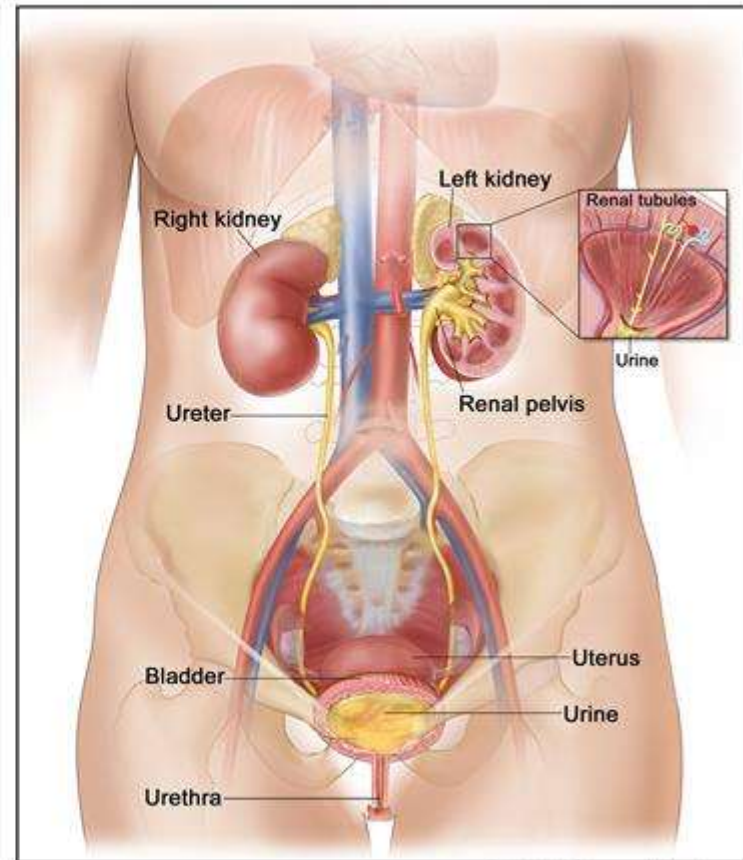
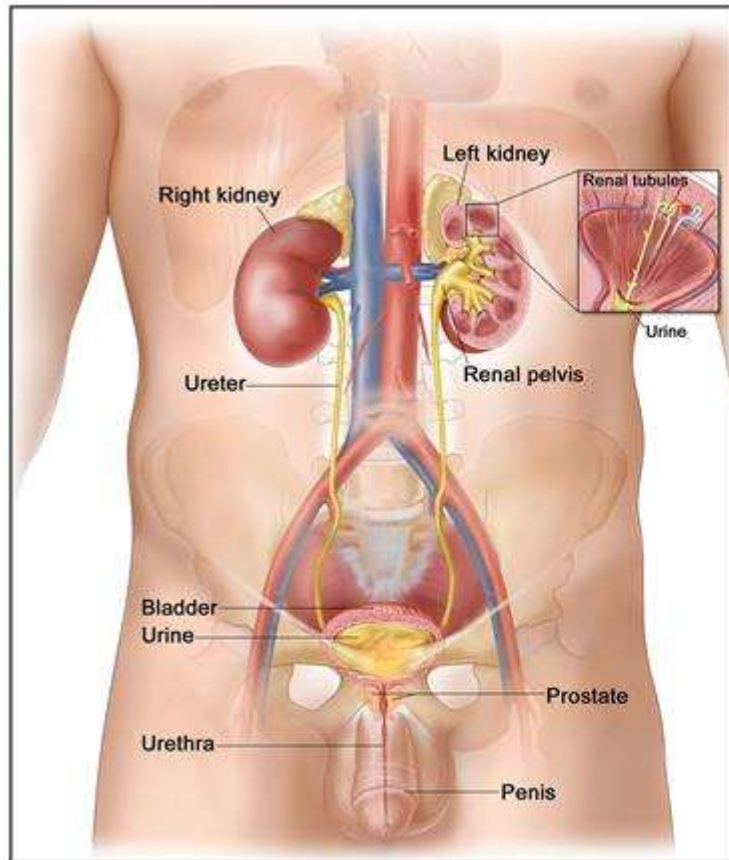
History-taking

(patient's interviewing)

- gathering of information
- patient's narrative
- biomedical perspective
- psychosocial perspective
- context

Patient's clinical examination

men and women' urinary tract

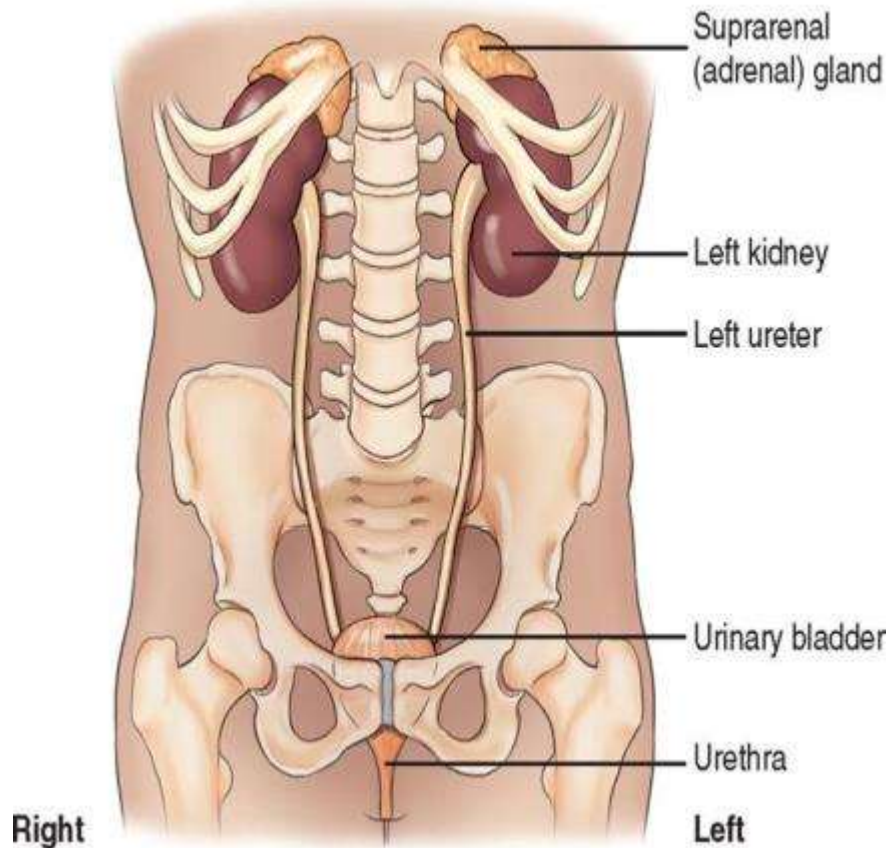


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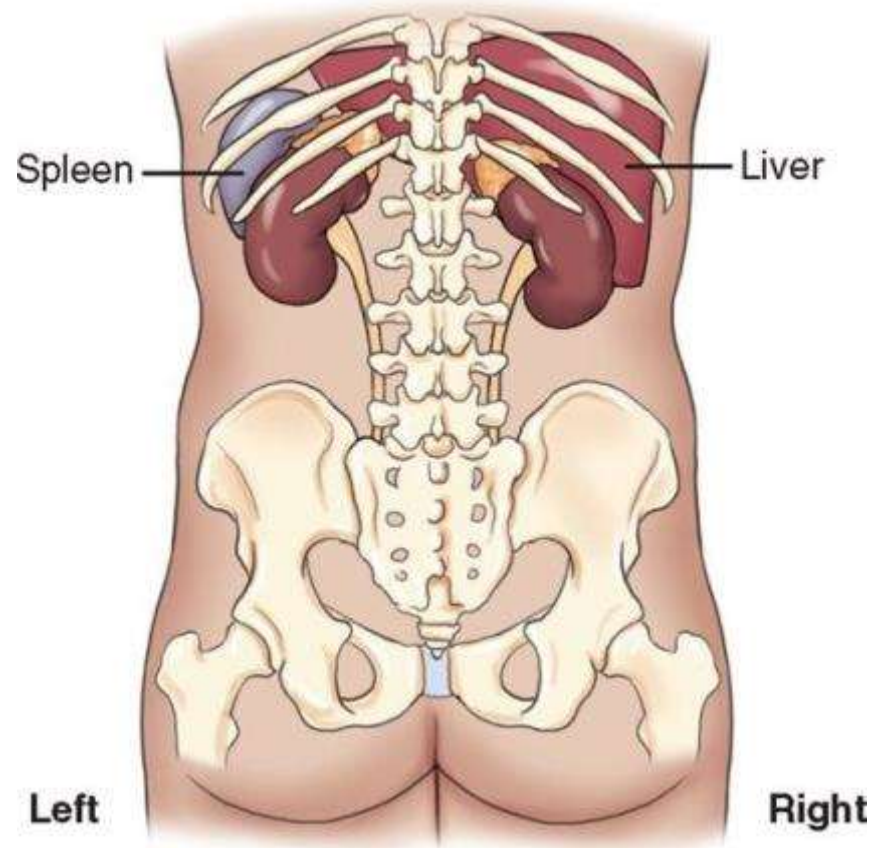
Patient's clinical examination

kidney skeletotomy

Anterior view



Posterior view



Patient's clinical examination

palpation of the right kidney



Physician Assistant Physical Assessment Ii

Patient's clinical examination

kidney pain localization



[Kidney Pain](#)

Patient's clinical examination

physical assessment: inspection

- general state of health- fatigue, lethargy, diminished alertness
- skin- pallor, yellow-gray, excoriations, changes in turgor, bruises, texture(e.g. rough, dry skin)
- mouth: stomatitis, ammonia breath
- face, extremities- generalized edema, peripheral edema, bladder distention, masses, enlarged kidney
- abdomen-abdominal contour for midline mass in lower abdomen (may indicate urinary retention) or unilateral mass
- weight: weight gain secondary to edema, weight loss and muscle wasting in renal failure

Patient's clinical examination

physical assessment: percussion, palpation, auscultation

- kidney - **percussion** (to detect areas of tenderness by costovertebral test, normally will feel a thudding sensation or pressure but not tenderness) and **palpation** (contour, size, tenderness, and lump) - in adult ordinary(usually) **it** won't be palpable because of their deep location. Presence of tenderness and pain indicates a kidney infection or polycystic kidney disease.
- bladder - **percussion** of the area over the bladder (5cm) above the symphysis pubis to detect difference in sound, percussion toward the base of the bladder, normally produces a tympanic sound, **palpation** normally gives firm and smooth feelings, in adults bladder may not be palpable
- urethral meatus - **inspection** for swelling, discharge and inflammation
- **auscultation**: the abdominal aorta & renal arteries are auscultated for a bruits, which indicate impaired blood flow to the kidneys

Patient's laboratory examination

blood and urine tests

Blood

- Serum Creatinine (0.5 – 1.2 mg/dl)
- Blood Urea Nitrogen (10-20 mg/dl)
- BUN/Creatinine Ratio (12:1 to 20:1 mass)

Urine

- Urinalysis
- Urine for C&S
- Composite (e.g., 24hr) urine collections
- Creatinine Clearance Test (is used to estimate Glomerular Filtration Rate)
- Urine Electrolytes
- Osmolality (plasma; urine)



Patient's laboratory examination

Glomerular Filtration Rate (GFR) is preferable to creatinine to evaluate the kidney function

- creatinine comes from muscle
- the normal creatinine ranges depend on body (muscle, lean) weight which in turn also depends on age and gender



- The little girl has normal kidney function and a creatinine level 0,6 mg/dL
- The body-builder has normal kidney function and a creatinine of 1,2 mg /dL
- For the girl, a creatinine of 1,2 mg/dL would be very poor kidney function.

Patient's laboratory examination

Glomerular filtration rate (GFR) and estimated GFR (eGFR)

- GFR is a test of how much the kidneys are filtering
- Norm = about 100 mL/min (This means that the kidneys are removing all the creatinine found in 100mls of blood every minute)
- Measured GFR - Injecting a tiny amount of a radioactive substance and measuring how quickly it disappears from the blood, or appears in the urine, is used to calculate GFR
- eGFR - Using blood tests, age, sex, and sometimes other information to estimate the GFR from the MDRD equation (eGFR). This isn't as good as measuring it, but is much simpler as it requires just one blood test.
- Creatinine clearance (blood creatinine measurements by collecting urine for 24 hours and measuring how much creatinine is in the urine at the same time as finding out how much is in the blood. *(If any urine produced during the 24 hours is not collected the result will not be accurate).*

Patient's laboratory examination

equations for eGFR and Ccr

– Abbreviated MDRD (Modification of Diet in Renal Disease) equation for eGFR

- $\text{eGFR (ml/min/1.73 m}^2\text{)} = 186 \times (\text{S.cr})^{-1.154} \times (\text{age})^{-0.203} \times (0.742 \text{ if female}) \times (1.210 \text{ if Black})$

Normal GFR is about 100ml/minute/1.73m²

– Cockcroft-Gault equation (in fact gives the creatinine clearance (CCr))

- $\text{CCr (ml/min)} = (140 - \text{age}) \times \text{lean body weight (kg)} \times 0.85 \text{ (if female)} / 72 \times \text{S.cr (mg/dl)}$

Normal creatinine clearance is about 100ml/minute

Patient's laboratory examination

staging of CKD based on eGFR

Stage	eGFR (ml/min)	Description
1	>90	Damage with normal or increased GFR
2	60-89	Mild decrease in GFR
3A	45-59	Moderate decrease in GFR
3B	30-44	Moderate decrease in GFR
4	15-29	Severe decrease in GFR
5	<15	Kidney failure
5D	<10	Dialysis

Patient's laboratory examination urinalysis



<https://www.youtube.com/watch?v=6TCIOB1vUvI>

Patient's laboratory examination urinalysis

- collection of urine specimens
 - first voided morning (most common)
 - random (for emergency)
 - clean-catch, midstream (for urine culture)
- Attention:* need to be examined within 1 hour
- urine specimens examination
 - physical (appearance, volume, specific gravity (SG))
 - chemical
 - microscopic examination
 - urine for culture and sensitivity

Urine specimens examination

physical appearance

- Color
 - normal, pale to dark yellow (urochrome)
 - abnormal
 - some drugs cause color changes
 - red urine (hematuria, hemoglobinuria, myoglobinuria, pseudohematuria)
 - yellow-brown or green-brown urine (bilirubin: obstructive jaundice)
- Clarity
 - normal, clear
 - abnormal, cloudy
 - crystals or nonpathologic salts
 - phosphate, carbonate in alkaline urine
 - uric acid in acid urine
 - various cellular elements (leukocytes, RBCs, epithelial cells)

Urine specimens examination

physical appearance: red urine

- microscopic hematuria (urinary tract source (urethra or bladder, prostate, ureter or kidney), non-urinary tract source (vagina, anus or rectum))
- pseudohematuria (myoglobinuria, hemoglobinuria, phenolphthalein laxatives, phenothiazines, porphyria, rifampin, pyridium, bilirubinuria, phenytoin, pyridium, red diaper syndrome, foods (beets, blackberries, rhubarb))
- causes of asymptomatic gross hematuria (acute cystitis, bladder cancer, benign prostatic hyperplasia, nephrolithiasis, benign essential hematuria, prostatitis, renal cancer, pyelonephritis, prostate cancer, urethral stricture)

Urine specimens examination

physical: urine volume

- normal adult average – (400 – 2000) ml/24h
- increase average (polyuria) – > 2000 ml/24h
 - physiological (water intake, some drugs, intravenous solutions)
 - pathologic (CKD, diabetes mellitus, diabetes insipidus)
- decrease average (oliguria - < 400 ml/24h, anuria - < 100ml /24h)
 - prerenal (hemorrhage, dehydration, congestive heart failure)
 - postrenal (obstruction of the urinary tract, may be stones, carcinoma)
 - renal parenchymal disease (acute tubular necrosis, chronic renal failure)

Urine specimens examination

physical: specific gravity (SG)

- density of the urine (compares the density of urine to the density of water)
- normal average in adults: 1.001 - 1.040
- increased (dehydration, fever, vomiting, diarrhea, diabetes mellitus, other glycosuria, congestive heart failure, syndrome of inappropriate ADH secretion (SIADH), adrenal insufficiency)
- decreased (urine volume ↓ and SG ↑) in diabetes insipidus (urine volume ↑ and SG ↓)

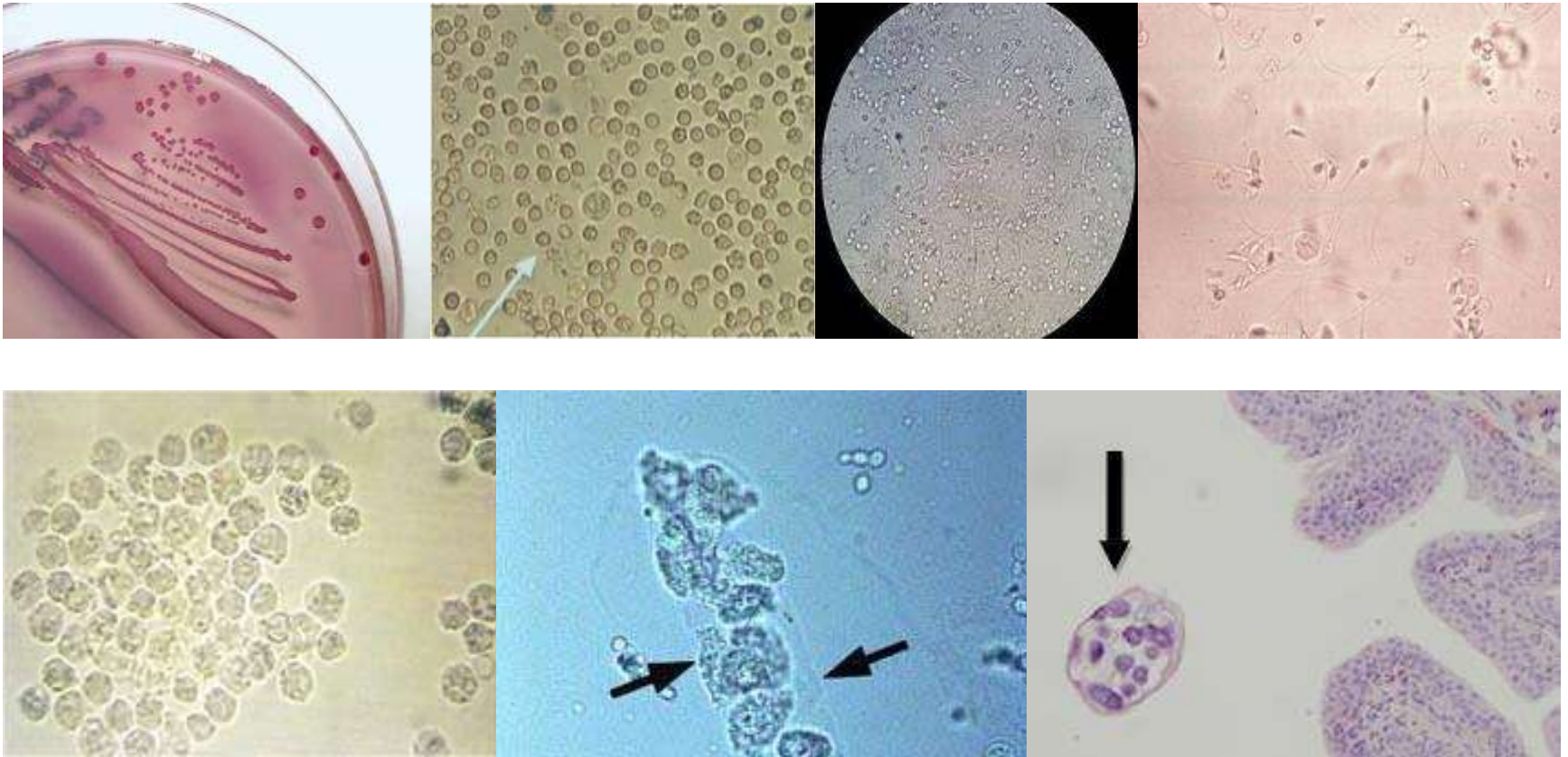
Urine specimens examination

physical: chemical examination

- urine PH: **normal** 5 - 9 (depends on diet), **increased** (alkaline urine: drugs (sodium bicarbonate), classic renal tubular acidosis, alkalosis (metabolic or respiratory), **decreased** (acid urine: drugs (ammonium chloride), acidosis (metabolic or respiratory))
- protein: **normal** <150mg/24h), higher > 150mg/24h (proteinuria: heavy >4.0 g/24h, moderate 1.0 - 4.0 g/24h, minimal <1.0 g/24h, microalbuminuria 30 mg - 300 mg/24 h) - glomerular (glomerular diseases damage glomerular basement membrane but tubular function is normal, selective proteinuria, heavy proteinuria, acute glomerulonephritis), tubular (renal tubular disease damage tubular function but glomerular is normal, moderate proteinuria, pyelonephritis), "overflow", functional, extra-renal
- glucose: normally negative, positive in diabetes mellitus, Cushing's syndrome, renal tubular dysfunction
- ketones: normally negative, ketonuria - diabetic, nondiabetic, hyperemesis of pregnancy, patients with vomiting or diarrhea
- occult blood: normally negative
- Bilirubin, urobilinogen: normally negative
- nitrites: normally negative, positive in presence of bacteria
- leukocyte esterase: bacteria, fungal, parasitic, tumor, nephritis

Urine specimens examination

physical: microscopic, urine for culture and sensitivity

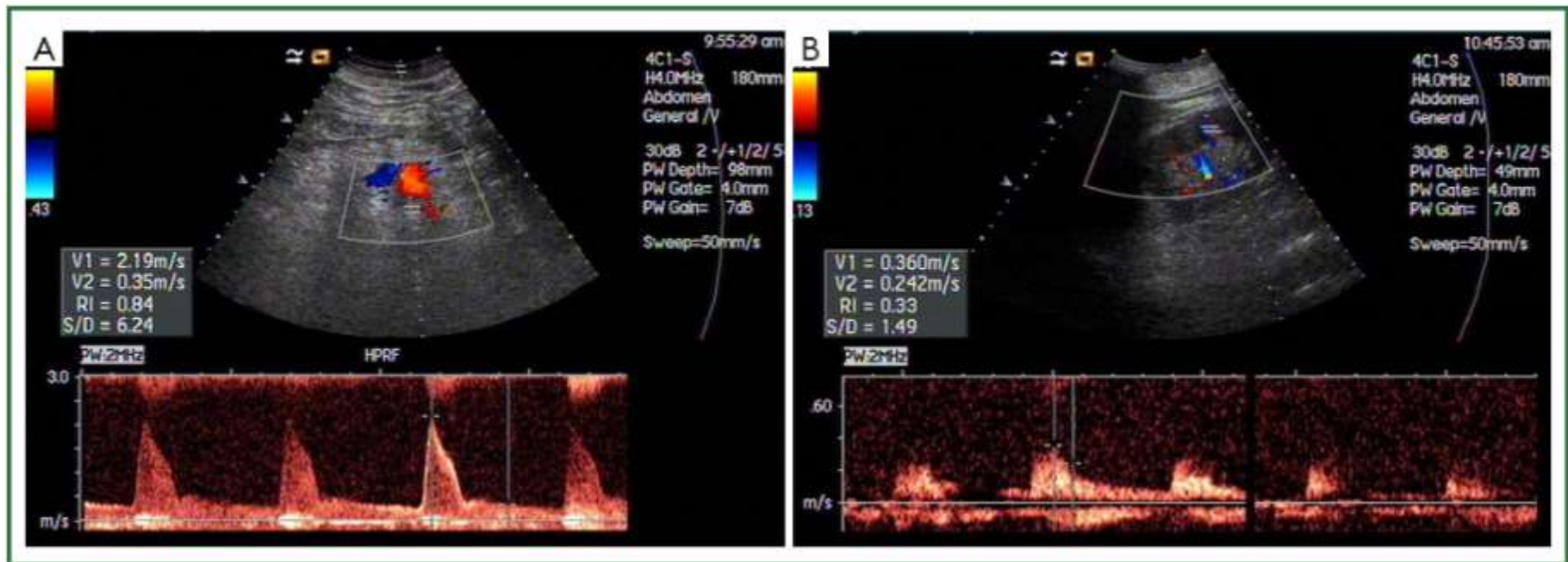


RBCs, WBCs, epithelial cells, bacteria, casts (cylindrical moulds, indicate damage to the glomerular basement membrane or tubule)

Patient's instrumental examination

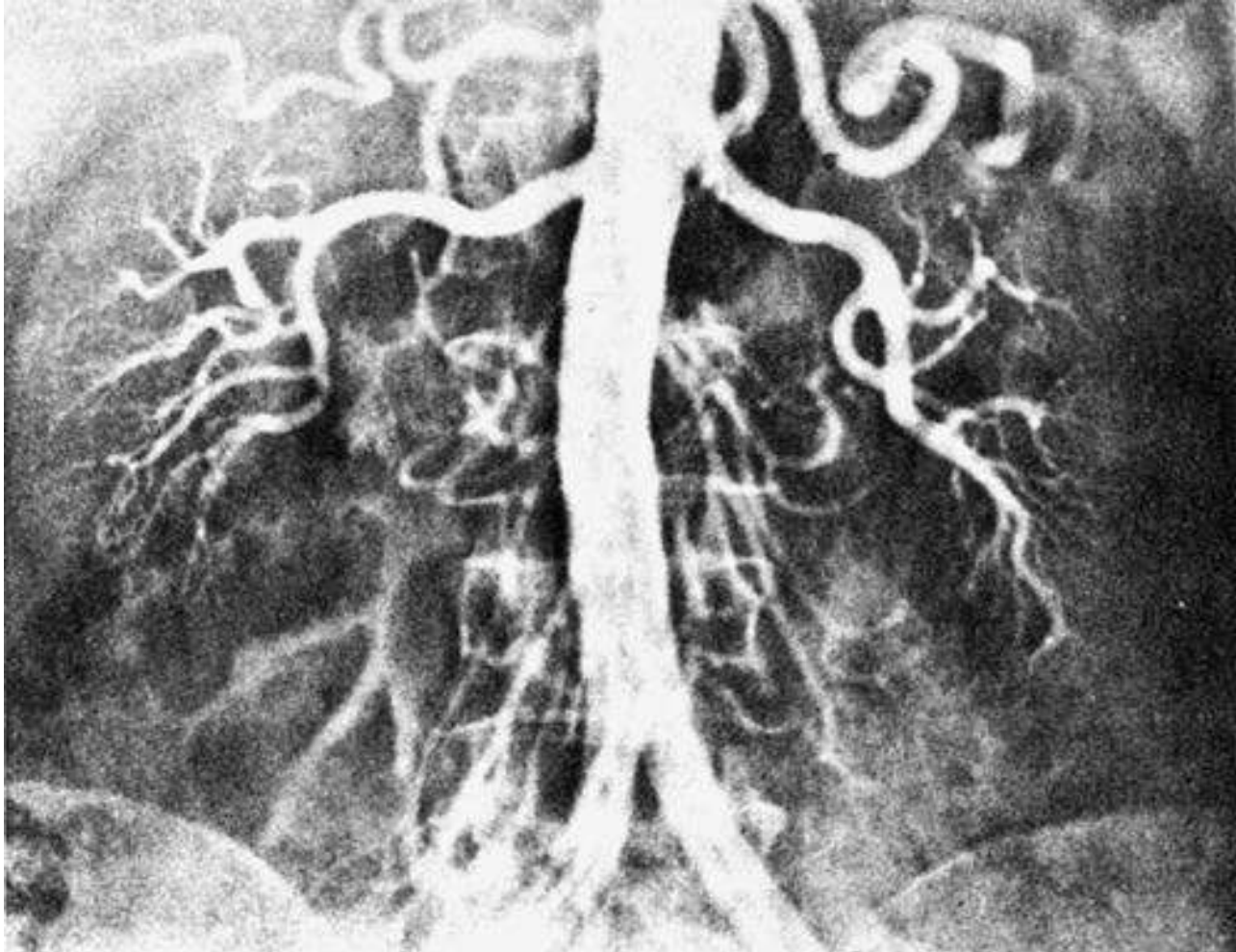
- Ultrasonography (B-mode scan, Doppler flow examination of renal vessels or duplex ultrasound scanning)
- radiographic examinations
 - kidneys, ureter, bladder X-ray
 - intravenous urography
 - computed tomography
 - cystography and cystourethrography
- other diagnostic tests
 - renal arteriography (angiography)
 - renal biopsy
 - renography (kidney scan)
 - magnetic resonance Imaging (MRI)

Patient's instrumental examination sonography



[Refractory hypertension with massive proteinuria](#)

Patient's instrumental examination renal arteriography



http://intranet.tdmu.edu.ua/data/kafedra/internal/vnutrmed2/classes_stud/en/med/lik/ptn/Internal%20medicine/6%20course/21.%20Management%20of%20%20patients%20with%20urinary%20syndrome.htm

Patient's instrumental examination urography



http://intranet.tdmu.edu.ua/data/kafedra/internal/vnutrmed2/classes_stud/en/med/lik/ptn/Internal%20medicine/6%20course/21.%20Management%20of%20%20patients%20with%20urinary%20syndrome.htm

Patient's instrumental examination

radiolucent stones



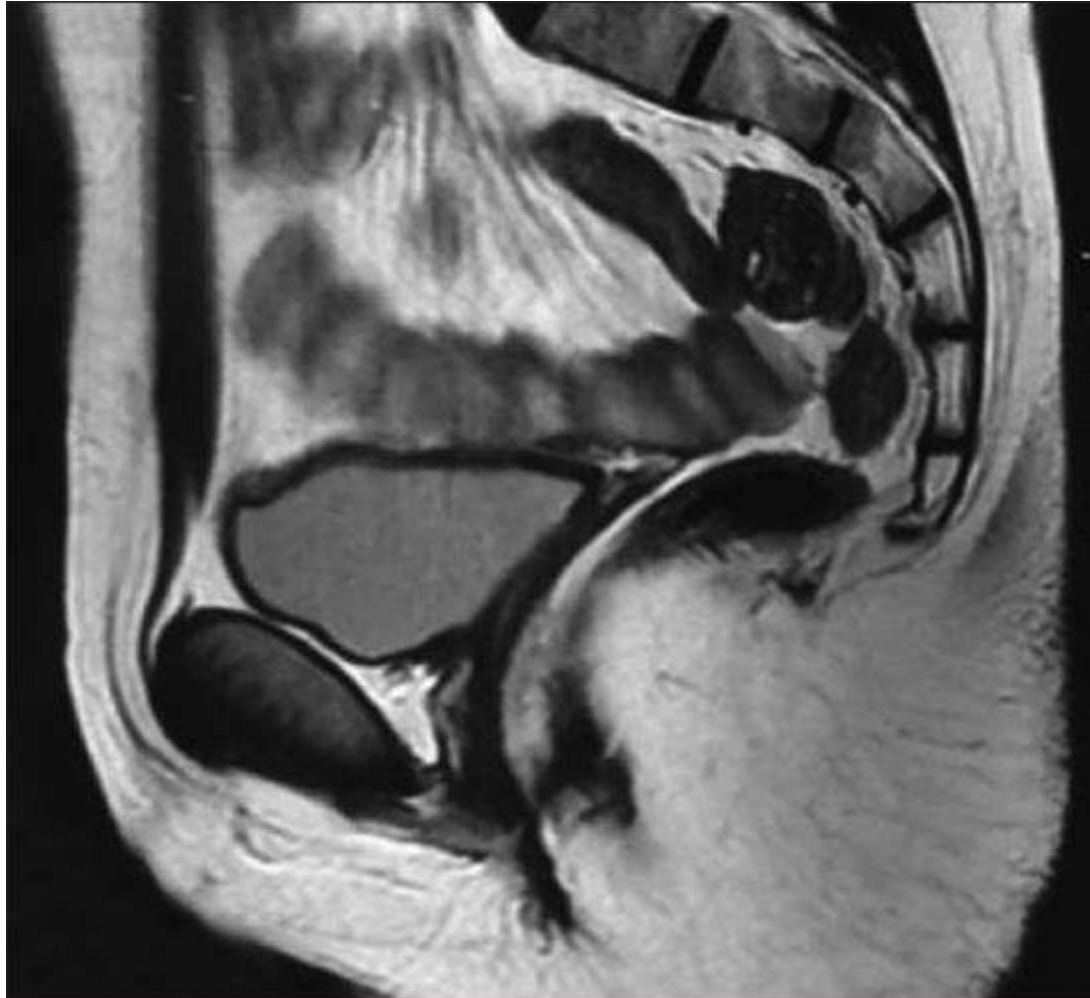
Bladder calculi (stones)

Patient's instrumental examination computer tomography



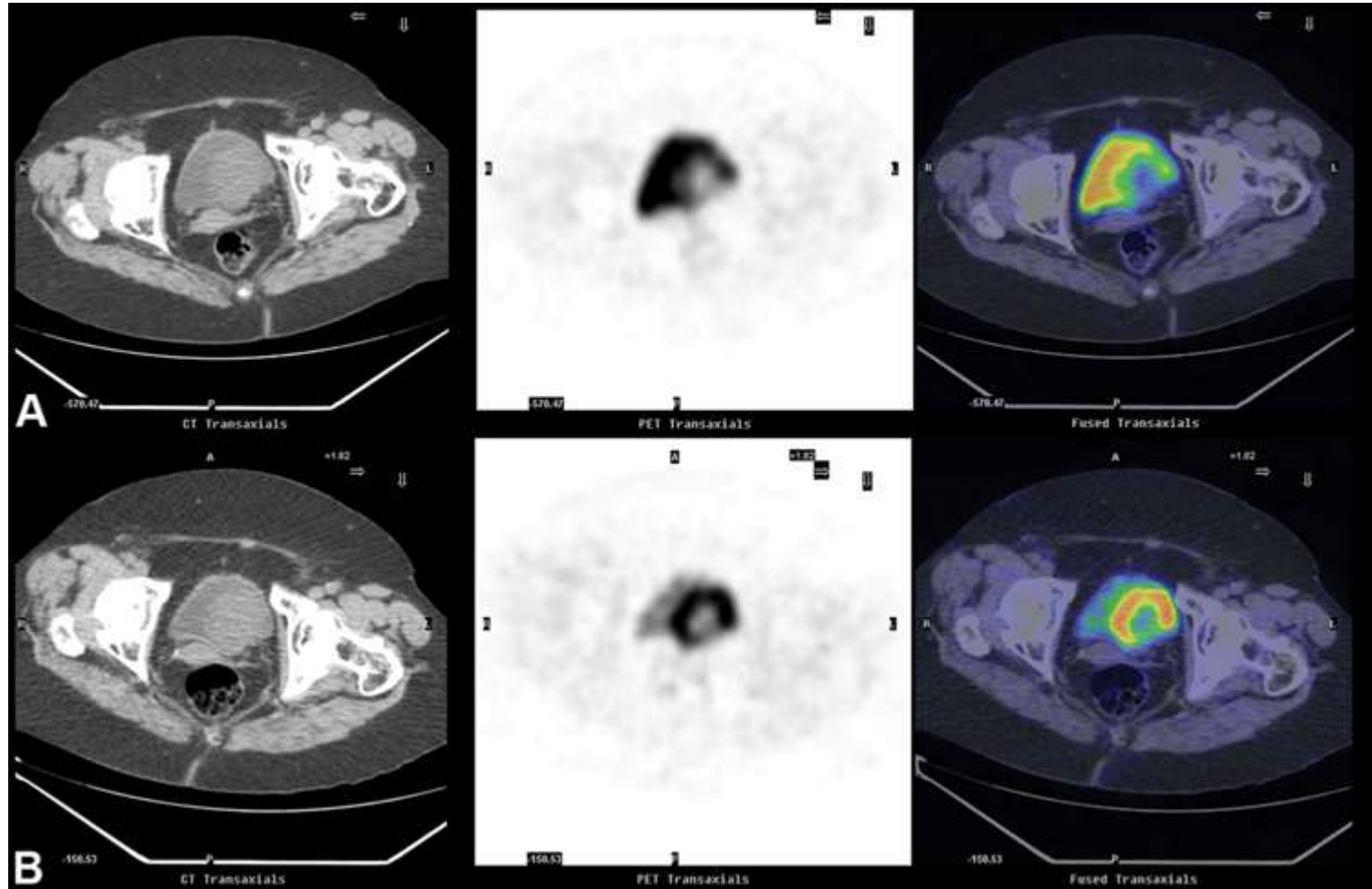
[Cystic Diseases of the Kidney](#)

Patient's instrumental examination magnetic resonance imaging

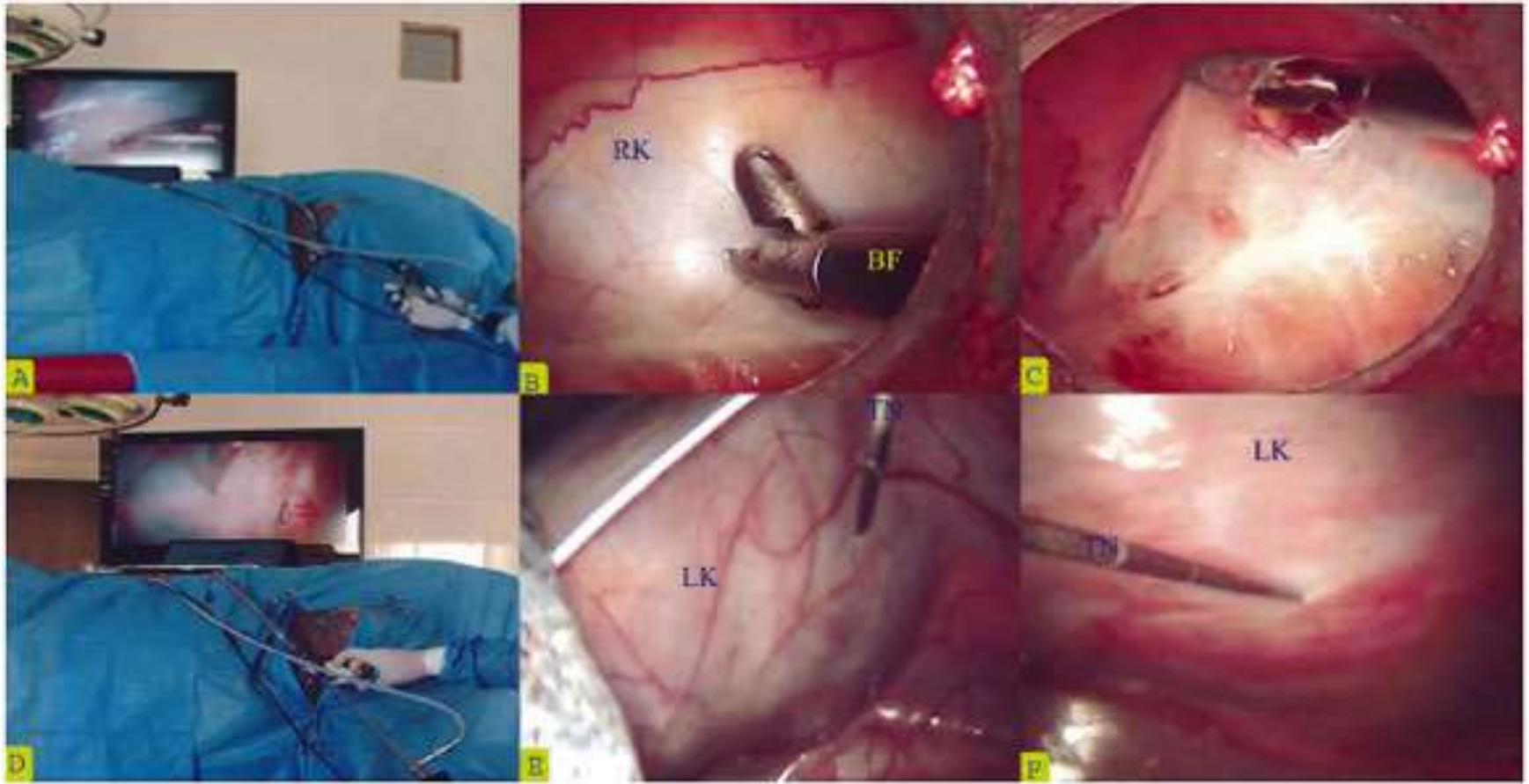


Gonadal dysgenesis

Patient's instrumental examination positron emission tomography

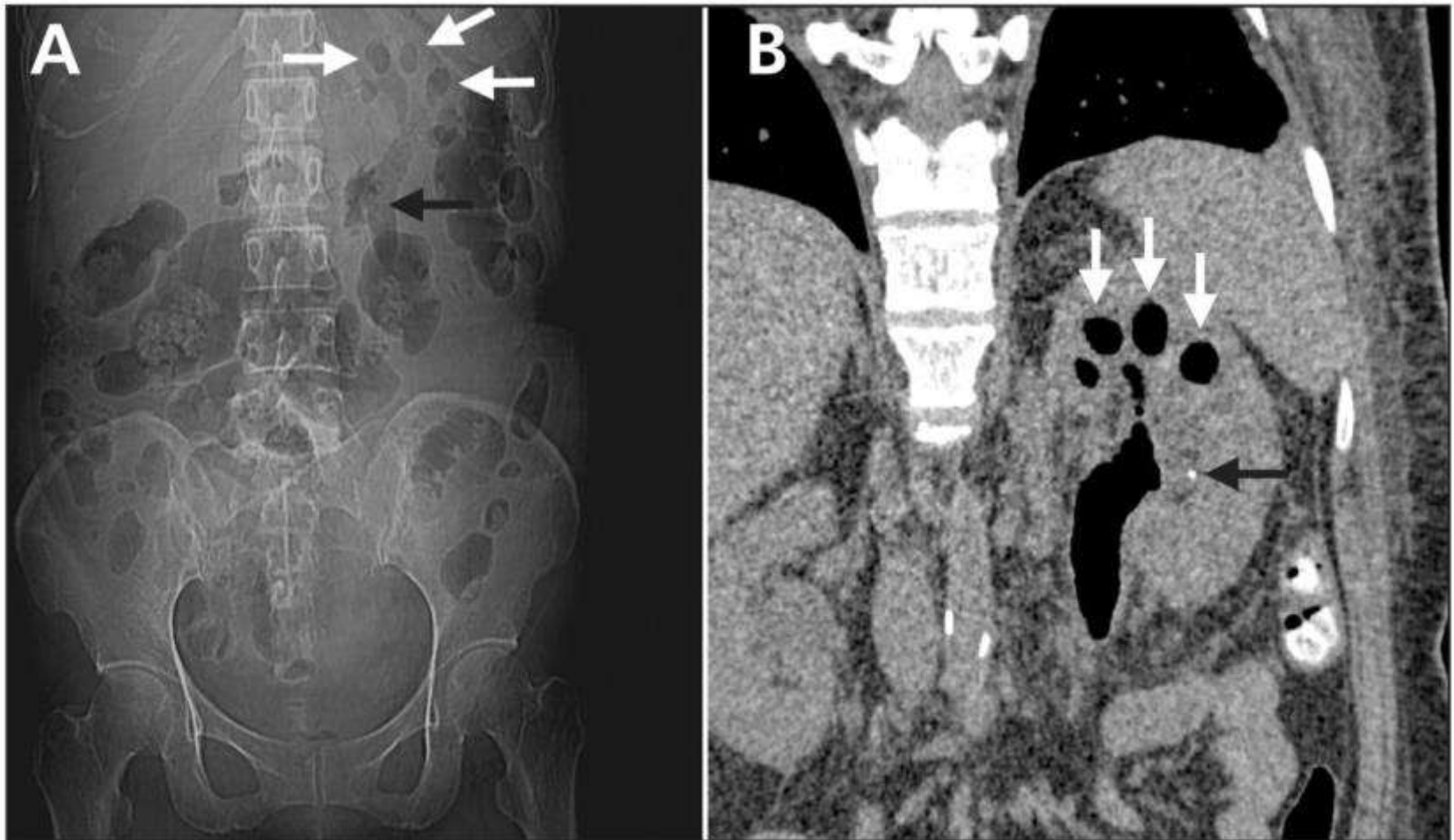


Patient's instrumental examination laparoscopic renal biopsy



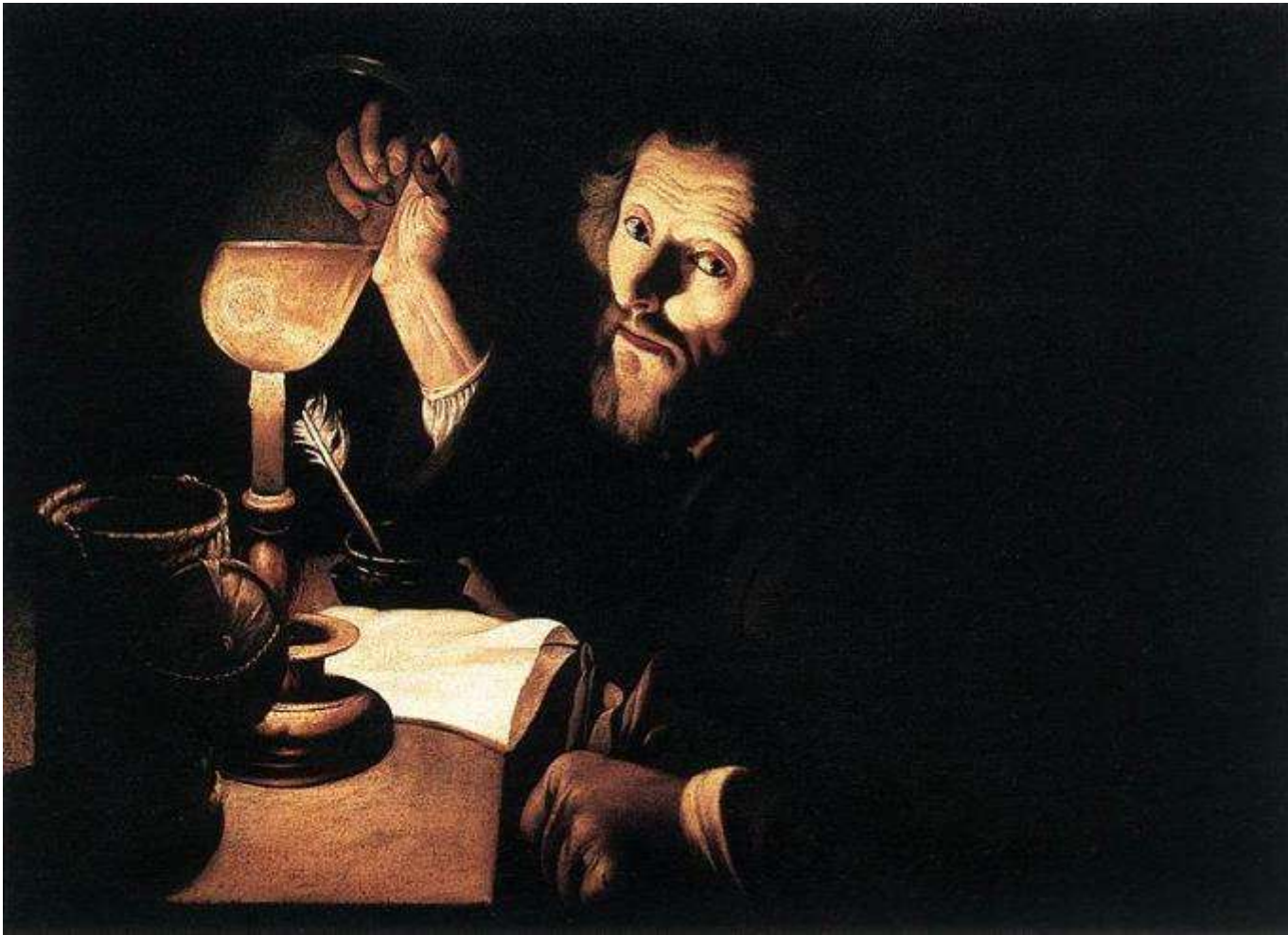
Patient's instrumental examination

plain radiography & abdominal computed tomography



[A Case of left Flank Pain](#)

Patient's instrumental examination urine by Bigot



<http://www.davidicke.com/forum/showthread.php?t=11956&page=1069>

Spectrum of urinary system diseases

- Congenital abnormalities
- Interstitial nephritis
- Glomerulonephritis
- Cystic kidney disease
- Renal vascular disease
- Nephrotic syndrome
- Renal failure
- Infections of the urinary tract
- Obstruction of the urinary tract
- Urinary tract calculi and nephrocalcinosis
- Malignancy of the urinary tract eg CA bladder
- Incontinence

Urinary system diseases' symptoms and syndromes

symptoms

- pain
- proteinuria
- azotaemia, leading to uraemia
- haematuria
- urinary casts
- hypertension
- oliguria or anuria
- oedema
- polyuria
- renal/ureteric colic
- dysuria
- renal failure
- general symptoms of abnormal renal function



Urinary system diseases' symptoms and syndromes

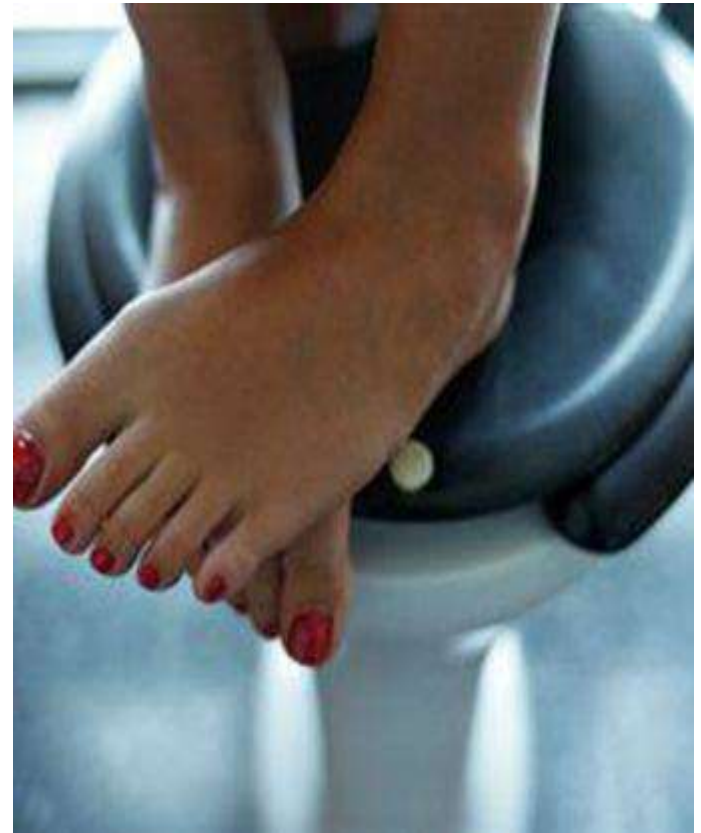
urinary syndrome: definition, symptoms

Definition

quantitative and qualitative
changes in urine

Symptoms

- changes in the volume and composition of the urine output
- changes in the rhythm of urinary excretion
- changes in the volume and composition of the blood



Urinary system diseases' syndromes

nephrotic syndrome: definition, criteria, types

Definition

Clinical and laboratory syndrome characterized by massive proteinuria, which lead to hypoproteinemia (hypoalbuminemia), hyperlipidemia and pitting edema in results from increased permeability of glomerular basement membrane (GBM) to plasma protein

Criteria

- hematuria (RBC in urine, gross hematuria)
- hypertension ($\geq 140/90$ mmHg)
- azotemia (renal insufficiency - Increased level of serum BUN , Cr)
- hypocomplementemia (decreased level of serum c3)

Types

idiopathic (90%), secondary (10%, anaphylactoid purpura , systemic lupus erythematosus, HBV infection, etc), congenital

Urinary system diseases' symptoms and syndromes

nephrotic syndrome: pathophysiology

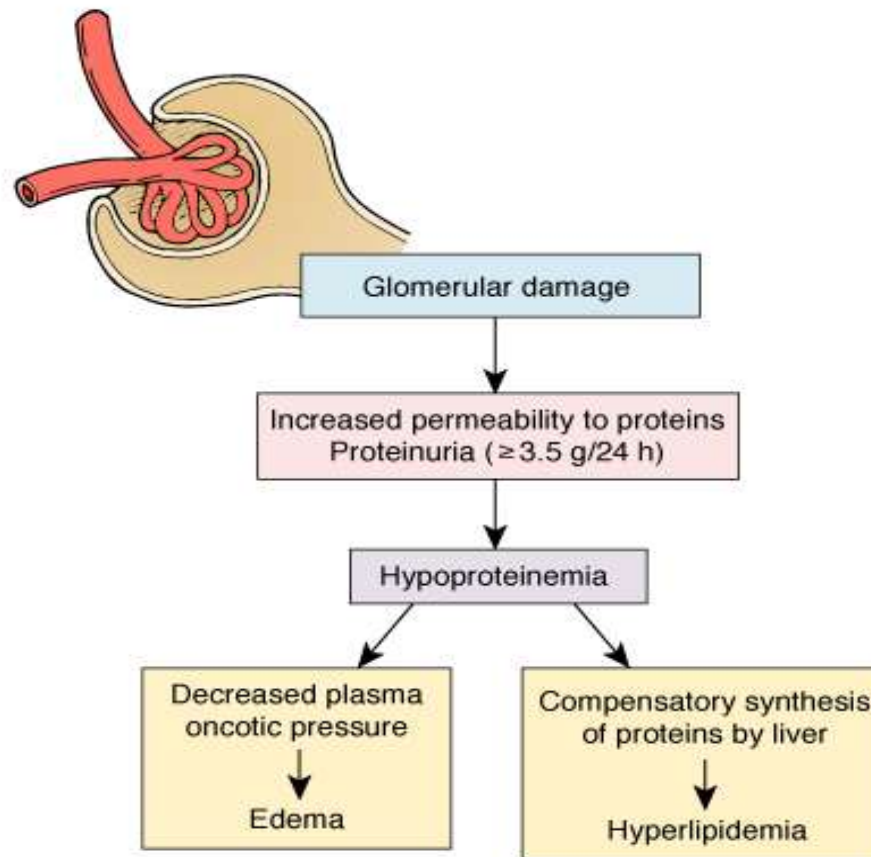


Figure 35-10 Pathophysiology of the nephrotic syndrome.

Urinary system diseases' symptoms and syndromes

nephrotic syndrome: degrees and types of proteinuria

Degrees

- mild $< 0.5\text{g/m}^2/\text{day}$
- moderate $0.5 - 2\text{g/m}^2/\text{day}$
- severe $> 2\text{g/m}^2/\text{day}$

Types

- Selective (where proteins of low molecular weight .such as albumin, are excreted more readily than protein of HMW)
- Non selective (LMW+HMW are lost in urine)

Urinary system diseases' symptoms and syndromes

nephrotic syndrome: symptoms, differential diagnosis

Symptoms

Edema (varying degrees) is the common symptom

Local: edema of face (facial edema), edema around eyes (periorbital swelling) , in lower extremities Generalized (anasarca), edema of penis and scrotum

Other clinical symptoms

fatigue, lethargy

loss of appetite, nausea and vomiting ,abdominal pain , diarrhea

body weight increase

urine output decrease

pleural effusion (respiratory distress)

Blood tests (serum protein $<5.5\text{gm/dL}$, albumin $<2.5\text{gm/dL}$, cholesterol $>220\text{mg/dl}$)

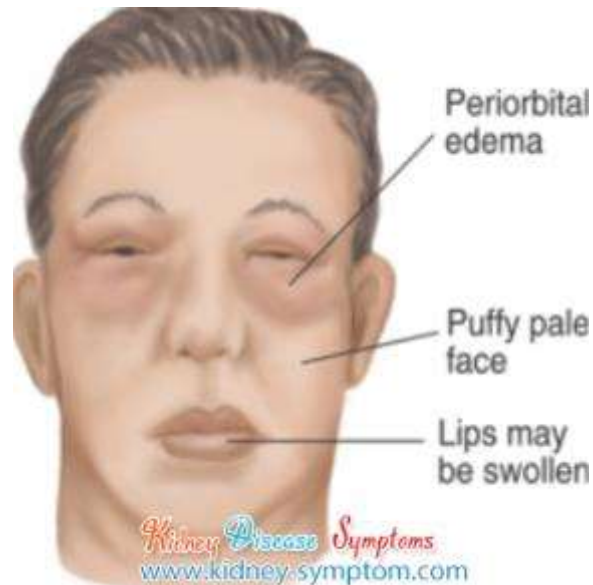
Urine tests (proteinuria, oliguria (during stage of edema formation), microscopic hematuria 20%, large number of hyaline casts)

Differential diagnosis of generalized edema

Urinary system diseases' symptoms and syndromes

main in nephrotic syndrome (all words contain letter O)

1. Massive prOteinuria
2. HypOprOteinemia (peeing oout albumin)
3. Oedema (ONcotic pressure in the blood goes down)
4. HyperchOlesterolemia (hyperlipidemia/hyperlipiduria)
5. HypercOagulable state (thrOmbotic and thrOmboembolic complications)



Urinary system diseases' syndromes

nephritic syndrome: definition, criteria, types

Definition

Clinical and laboratory syndrome associated with disorders affecting the kidneys, more specifically glomerular structures, and characterized by having a thin glomerular basement membrane and small pores in the podocytes of the glomerulus, large enough to permit proteins (proteinuria) and red blood cells (hematuria) to pass into the urine

Criteria

- hematuria , with red blood cell (RBC) casts present in the urine
- proteinuria (<3.5 g/day)
- hypertension
- uremia, due to retention of waste products
- variable renal insufficiency, with azotemia, oliguria (low urine output <400 mL/day)

Types

- post-streptococcal glomerulonephritis
- crescentic glomerulonephritis (rapidly progressive glomerulonephritis)

Urinary system diseases' symptoms and syndromes

nephritic syndrome: symptoms, differential diagnosis

Symptoms

- hematuria (e.g. cola coloured)
- proteinuria
- Hypertension (with headache)
- oliguria
- flank pain
- general symptoms
- post-infectious (2-3 weeks after strep-throat/URTI)

Differential diagnosis

- malignancy (older patients)
- UTI
- trauma



Urinary system diseases' symptoms and syndromes

nephritic syndrome (characterized by inflammation; both words contain letter i)

Nephritic syndrome features **PHARAOH**

Proteinuria

Haematuria

Azotaemia (elevated blood nitrogen levels)

Red blood cell casts

Anti-streptolysin O titres if post-streptococcal infection

Oliguria (output <0.5ml/kg/hour)

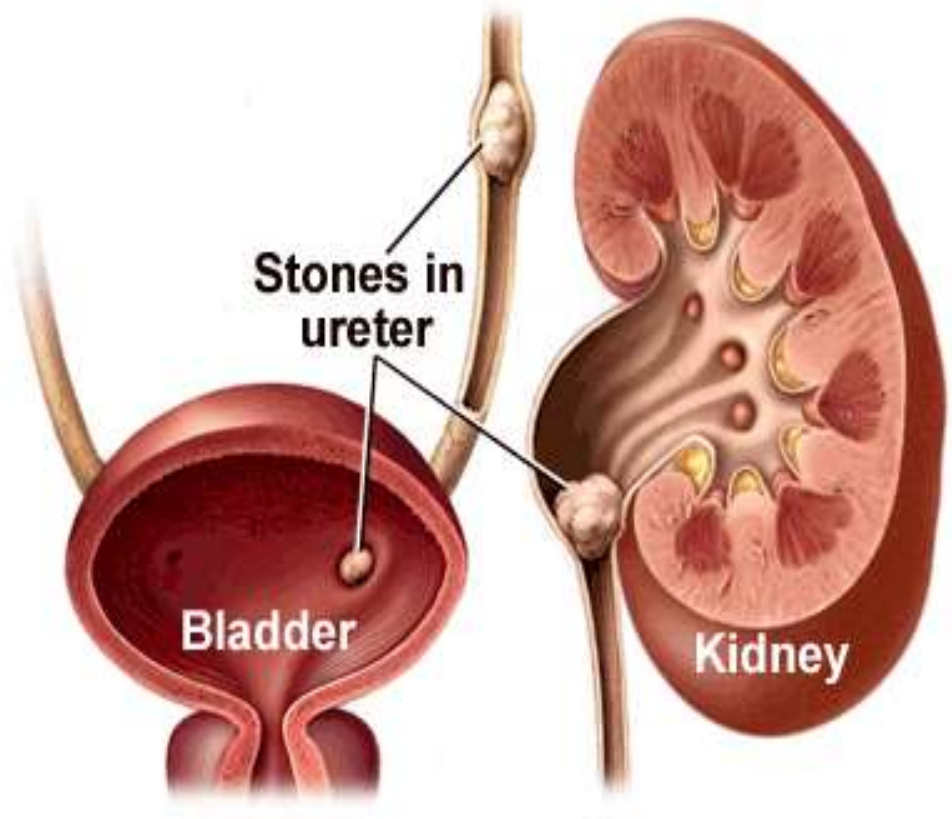
Hypertension



Urinary system diseases' symptoms and syndromes

urinary tract obstruction syndrome

- urinary tract obstruction can occur at any point in the urinary tract, from the kidneys to the urethral meatus
- it can develop secondary to calculi, tumors, strictures, anatomical abnormalities, or functional abnormalities
- obstructive uropathy can result in pain, urinary tract infection, loss in renal function, or, possibly, sepsis or death



Urinary system diseases' symptoms and syndromes

urinary upper tract obstruction syndrome

Symptoms of obstruction of the upper tract are typified by the symptoms of ureteral stricture or ureteral or renal stone. The principal complaints are pain in the flank radiating along the course of the ureter, gross total hematuria (from stone), gastrointestinal symptoms, chills, fever, burning on urination, and cloudy urine with onset of infection, which is the common consequence of obstruction or vesicoureteral reflux

Nausea, vomiting, loss of weight and strength, and pallor are due to uremia secondary to bilateral hydronephrosis
Anemia, leukocytosis, microscopic hematuria/

Ureter

- In the early stages intravesical pressure is normal
- Later added stretch effect at the lower end of the ureter induces further hydronephrosis
- Finally because of increased pressure the ureteral wall becomes attenuated



Urinary system diseases' symptoms and syndromes

urinary mid tract obstruction syndrome

Typified by the **symptoms** of urethral stricture, benign prostatic hyperplasia, neurogenic bladder, and tumor of the bladder involving the vesical neck.

The principal symptoms are hesitancy in starting urination, lessened force and size of the stream, and terminal dribbling; hematuria, which may be partial, initially, with stricture or total with prostatic obstruction or vesical tumor, cloudy urine (due to complicating infection), acute urinary retention. Anemia, leukocytosis, microscopic hematuria.

Stages

- compensation - the bladder musculature becomes hypertrophied → the thickness may double or triple, hypertrophied muscle may be seen endoscopically → superimposed with secondary infection (edema of the submucosa, infiltrated with plasma cells, lymphocytes, and polymorphonuclear cells)
- decompensation - large obstructing gland can be palpated rectally and observed cystoscopically, may appear as a mild obstruction cystoscopically



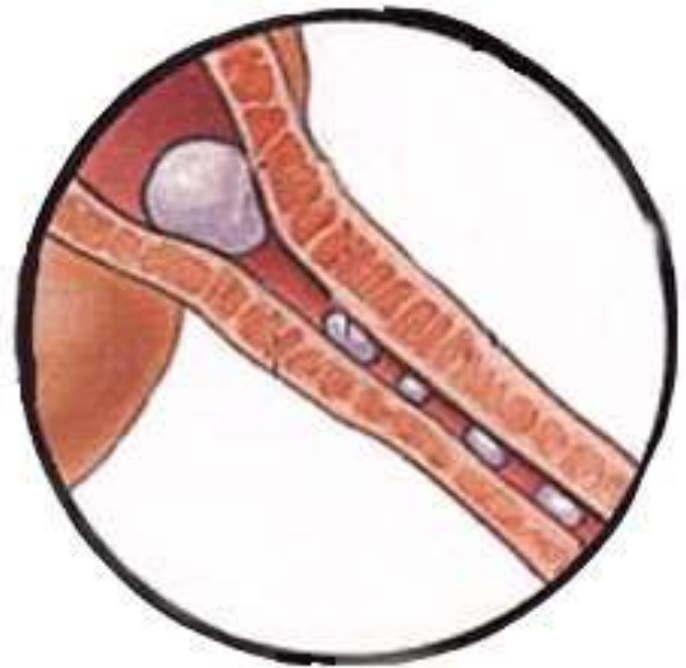
Urinary system diseases' symptoms and syndromes

urinary lower tract obstruction syndrome

The principal symptoms are hesitancy in starting urination, lessened force and size of the stream, and terminal dribbling; hematuria, which may be partial, initially, with stricture or total with prostatic obstruction or vesical tumor; cloudy urine (due to complicating infection), acute urinary retention. Anemia, leukocytosis, microscopic hematuria.

Obstruction → Hydrostatic pressure proximal → dilation of the urethra → The wall of the urethra becomes thin → formation of diverticulum → Infected urine + urinary extravasation → periurethral abscess.

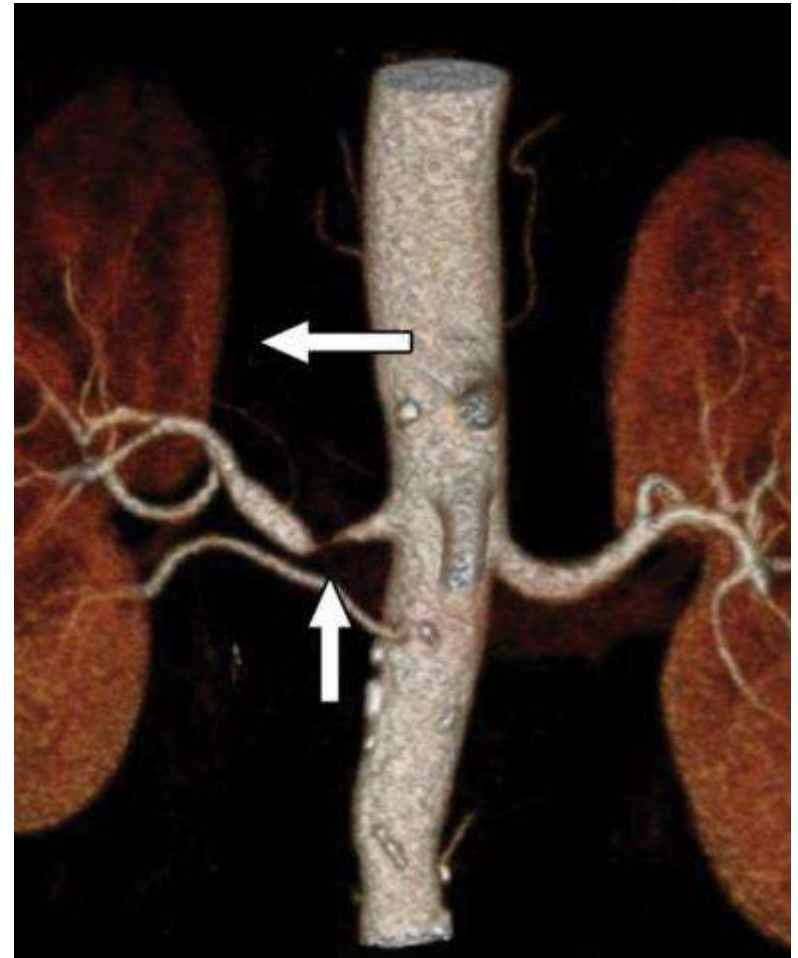
Typified by the symptoms of urethral stricture, benign prostatic hyperplasia, neurogenic bladder, and tumor of the bladder involving the vesical neck.



Urinary system diseases' symptoms and syndromes

hypertensive syndrome

- elevated $\geq 140/90$ mm Hg blood pressure (renal or renovascular hypertension), caused by a narrowing in the arteries that deliver blood to the kidney (renal artery stenosis)
- when the kidneys receive low blood flow, they respond by releasing hormones that stimulate the body to retain sodium and water, blood vessels fill with additional fluid, and blood pressure increases
- the narrowing in one or both renal arteries is most often caused by atherosclerosis, or hardening of the arteries
- symptoms: headache, confusion, blurred or double vision, bloody (pink-colored) urine, nosebleed, bruits over affected renal artery
- hypertension can cause chronic kidney disease



Lecture 16

Syndromes of the musculoskeletal system and
connective tissue diseases

Plan of the lecture

- Musculoskeletal and Connective Tissue System (**MS**)
- Spectrum of the Musculoskeletal and Connective Tissue System Disorders (**MSDs**)
- MSDs' Methods of Examination
- MSDs' Signs and Symptoms
- Glossary of Terms referred to the MSDs

Musculoskeletal System (MS)

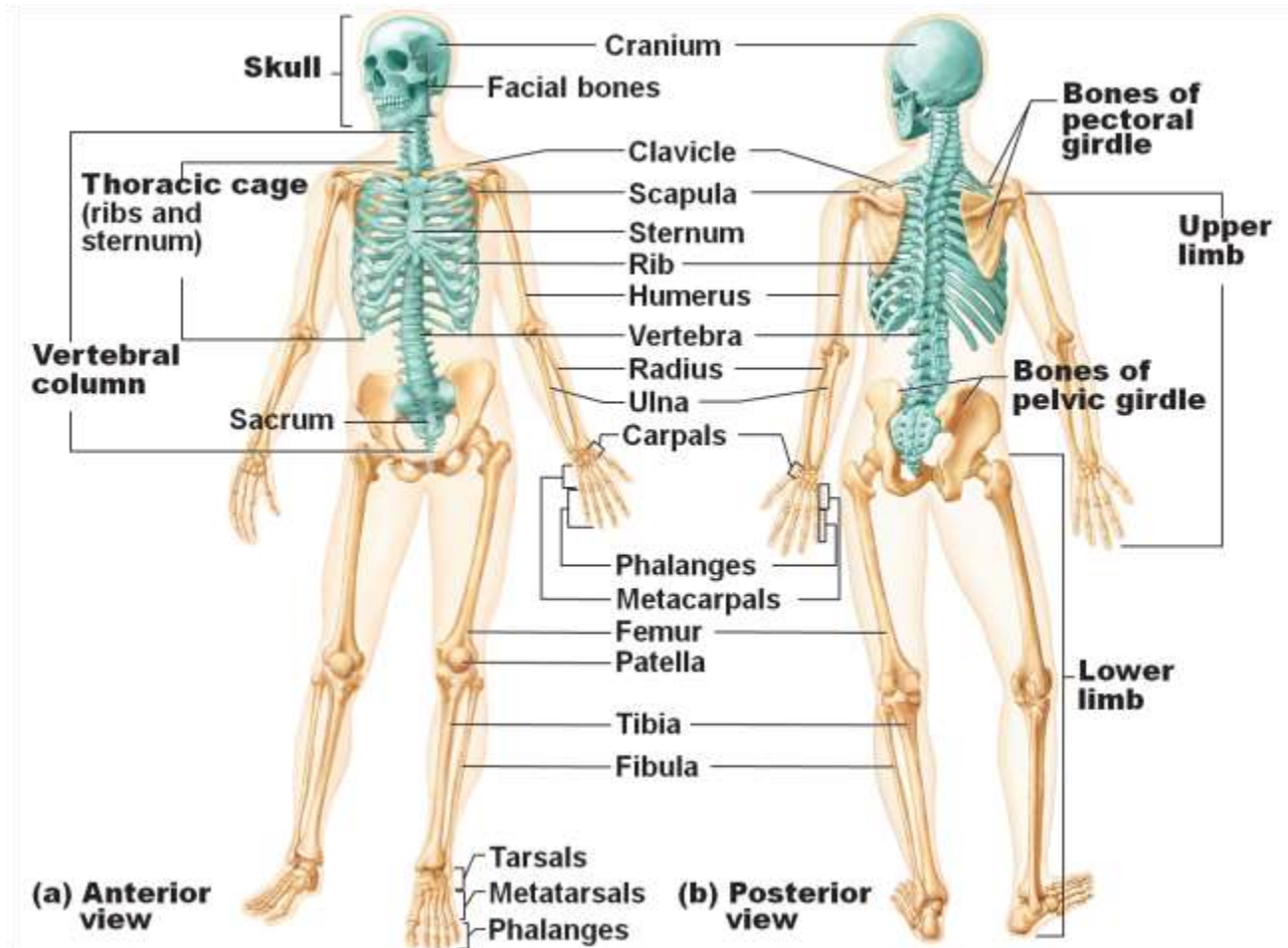
The musculoskeletal (locomotors) system gives the ability to move using the skeletal (skeleton) and muscular portions



MS: Skeleton and bones

- The skeleton provides the shape for the body, support and protection, allows body movement
- The skeleton is composed of bones supported by ligaments, tendons, muscles and cartilage
- An adult skeleton consists of 206 bones
- The skeleton stores minerals and lipids (99% of the body's calcium is found in the bones, the bones also store energy reserves as lipids in yellow marrow), produce blood cells in the red marrow, which fills the internal cavities of many bones

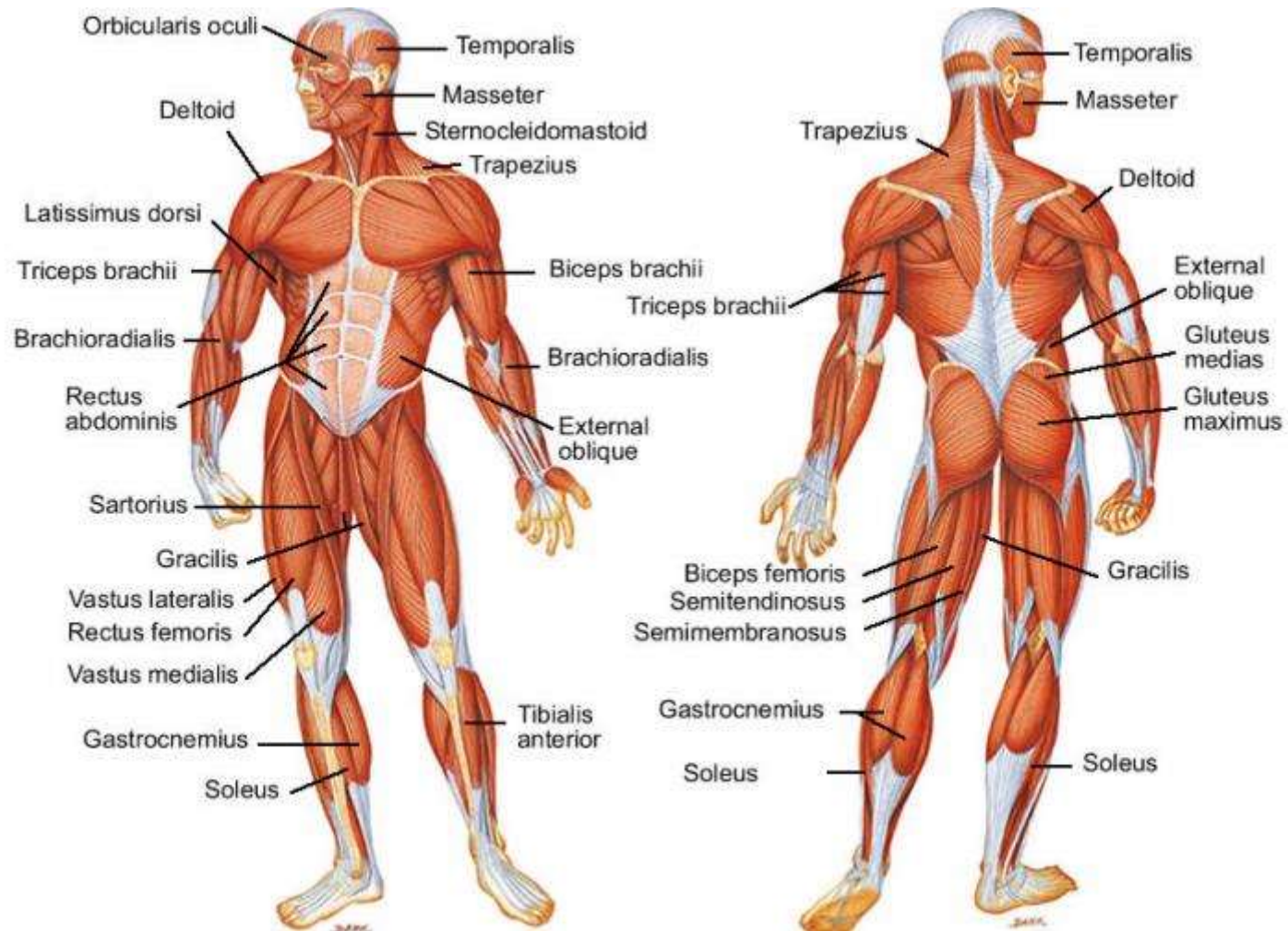
MS: Skeleton and bones



MS: Muscles

- There are skeletal, cardiac, and smooth types of muscles
- Only skeletal and smooth muscles are part of the **MS** and only the skeletal muscles can move the body
- Skeletal muscles are attached to bones and arranged in opposing groups around joints
- Skeletal muscles are innervated by nerves, which cause the muscles to contract
- Skeletal muscles contraction is stimulated by the motor neuron sending a message to the muscles from the somatic nervous system
- Skeletal muscles maintain body temperature

MS: Muscles

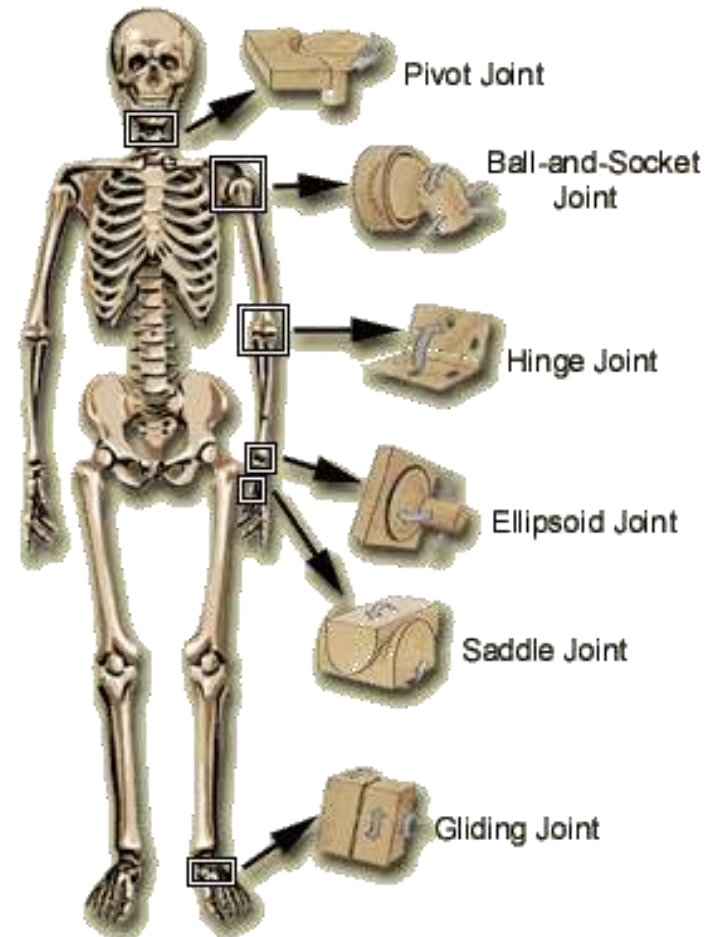


MS: Tendons

- A tendon is a tough, flexible band of fibrous connective tissue that connects muscles to bones
- The extra-cellular connective tissue between muscle fibers binds to tendons at the distal and proximal ends, and the tendon binds to the periosteum of individual the sites of muscle's beginning and insertion
- As muscles contract, tendons transmit the forces to the relatively rigid bones, pulling on them and causing movement
- Tendons can stretch substantially, allowing them to function as springs during locomotion, thereby saving energy

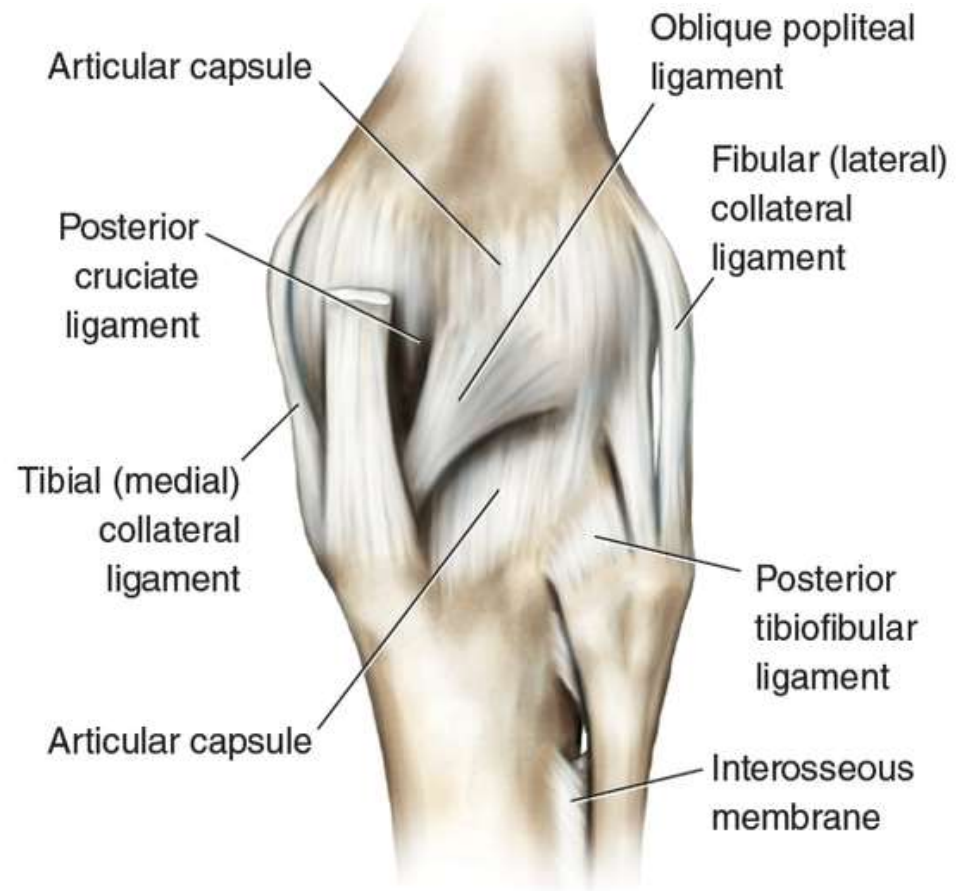
MS: Joints

- Joints connect individual bones and may allow bones to move against each other to cause movement:
 - Diarthroses which allow extensive mobility between two or more articular heads
 - False joints or synarthroses, joints that are immovable, that allow little or no movement and are predominantly fibrous
 - Synovial joints are lubricated by a solution called synovial fluid that is produced by the synovial membranes



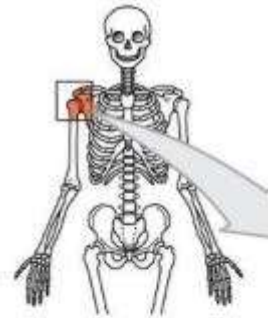
MS: Ligaments

A ligament is a small band of dense, white, fibrous elastic tissue, and connects the ends of bones together in order to form a joint



MS: Bursa

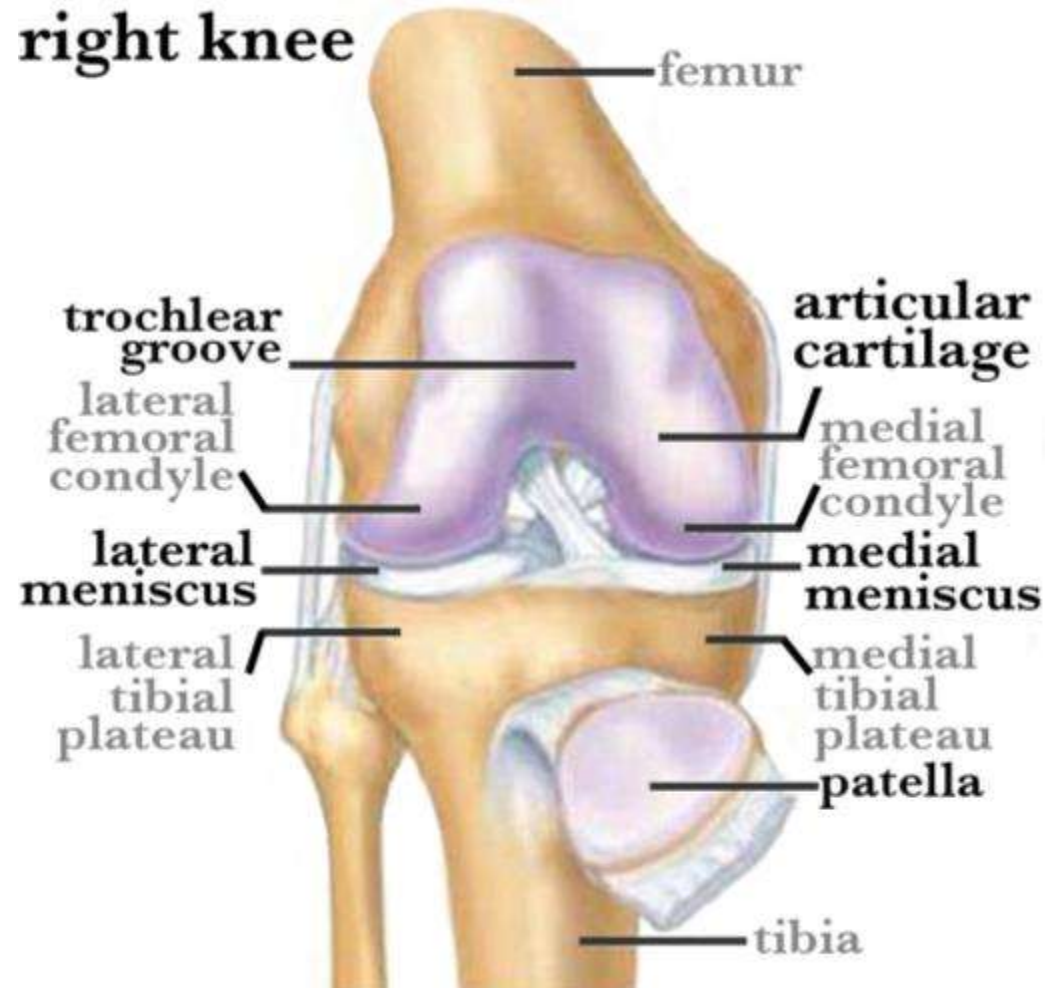
A bursa is a fluid-filled sac made of fibrous tissue and lined with synovial membrane, it provides a cushion between bones and tendons and/or muscles around a joint



MS: Cartilage

- Cartilage is a type of connective tissue. There are three types of cartilage: hyaline cartilage, elastic cartilage, and fibrocartilage
 - Hyaline cartilage is the most common type of cartilage, it provides stiff but somewhat flexible support
 - Elastic cartilage provides support but can tolerate distortion without damage and return to its original shape
 - Fibrocartilage resists compression, prevents bone-to-bone contact, and limits relative movement

MS: Cartilage



Spectrum of **MS** Disorders (**MSDs**)

- **MSDs** are heritable and acquired degenerative and inflammatory conditions that cause pain and impair normal activities in the body's joints, ligaments, muscles, nerves, tendons, and structures that support limbs, neck and back
- **MSDs** can arise from a sudden, or they can arise from making the same motions repeatedly repetitive strain, or from repeated exposure to force, vibration, or awkward posture
- Abrasions, contusions, and fractures that occur from sudden physical contact with objects that might occur in an accident are not considered **MSDs**

MSDs: Degenerative

Heritable

- Marfan syndrome (causing abnormal fibrillin)
- Osteogenesis imperfecta (brittle bone disease, caused by insufficient production of normal collagen)
- Ehlers-Danlos syndrome (defect in the synthesis of collagen, affecting joints, heart valves, organ walls, arterial walls, atc)

Acquired

- Osteoporosis
- Others

MSDs: Other



Scurvy – caused by a dietary deficiency in vitamin C, leading to abnormal collagen

MSDs: Acquired

Autoimmune

- Systemic Lupus Erythematosus (SLE, can afflict every organ system)
- Rheumatoid Arthritis (a systemic disorder in which immune processes inflame the joints, and can affect the heart, lungs, and eyes)
- Scleroderma (an activation of immune process produces scar tissue in the skin, internal organs, and small blood vessels)
- Sjögren's syndrome (Sjögren's disease, a chronic, slowly progressing inability to secrete saliva and tears)
- Psoriatic arthritis (a collagen vascular disease), atc/
- Others

MSDs: Diagnosis

- Since degenerative or inflammatory process involves soft tissue, there are often no visible signs of injury
- Assessments are based on self-reports by people as to whether or not they are experiencing pain
- A popular measure of MSDs is the Nordic Questionnaire that has a picture of the body with various areas labeled and asks the individuals to indicate in which areas they have experienced pain, and in which areas the pain has interfered with normal activity

MSDs: Diagnosis

[Nordic questionnaire for musculoskeletal disorders pdf](#)

[>>>CLICK HERE<<<](#)

MSDs: History of Presenting Complaint

- Character- What is the pain like?
- Location- Where does it start? Ask specifically (joint distribution)
- Onset- When and how did it come on? (acute vs. gradual/insidious)
- Radiation- Does the pain move/travel anywhere? Deep pain can be poorly localized.
- Intensity- Scale of 1 to 10; effect on ADL and IADLs. Is it getting better, worse, the same?
- Duration- How long as it been there?
- Pattern: intermittent, migratory, or additive
- Events associated: Falls, morning stiffness/swelling/redness, joint clicking or locking, muscle pain/cramping, wasting, limitation of movement/weakness, numbness/tingling, fevers/chills/night sweats/wt loss, trauma, job vs sports vs repetitive movements?
- Frequency- New vs recurrent pain
- Palliative factors- what makes the pain better? (rest/activity/pain meds/heat or cold?)
- Provocative factors- As above, but what makes pain worse?

MSDs: Blood tests

Markers of Inflammation

- Full blood count (a raised white cell count suggests possible infection)
- erythrocyte sedimentation rate (ESR, a normal ESR excludes an inflammatory process)
- C-Reactive Protein (CRP, a normal CRP excludes an inflammatory process)
- Complement
- leukocyte function tests (flow cytometry)

MSDs: Blood tests

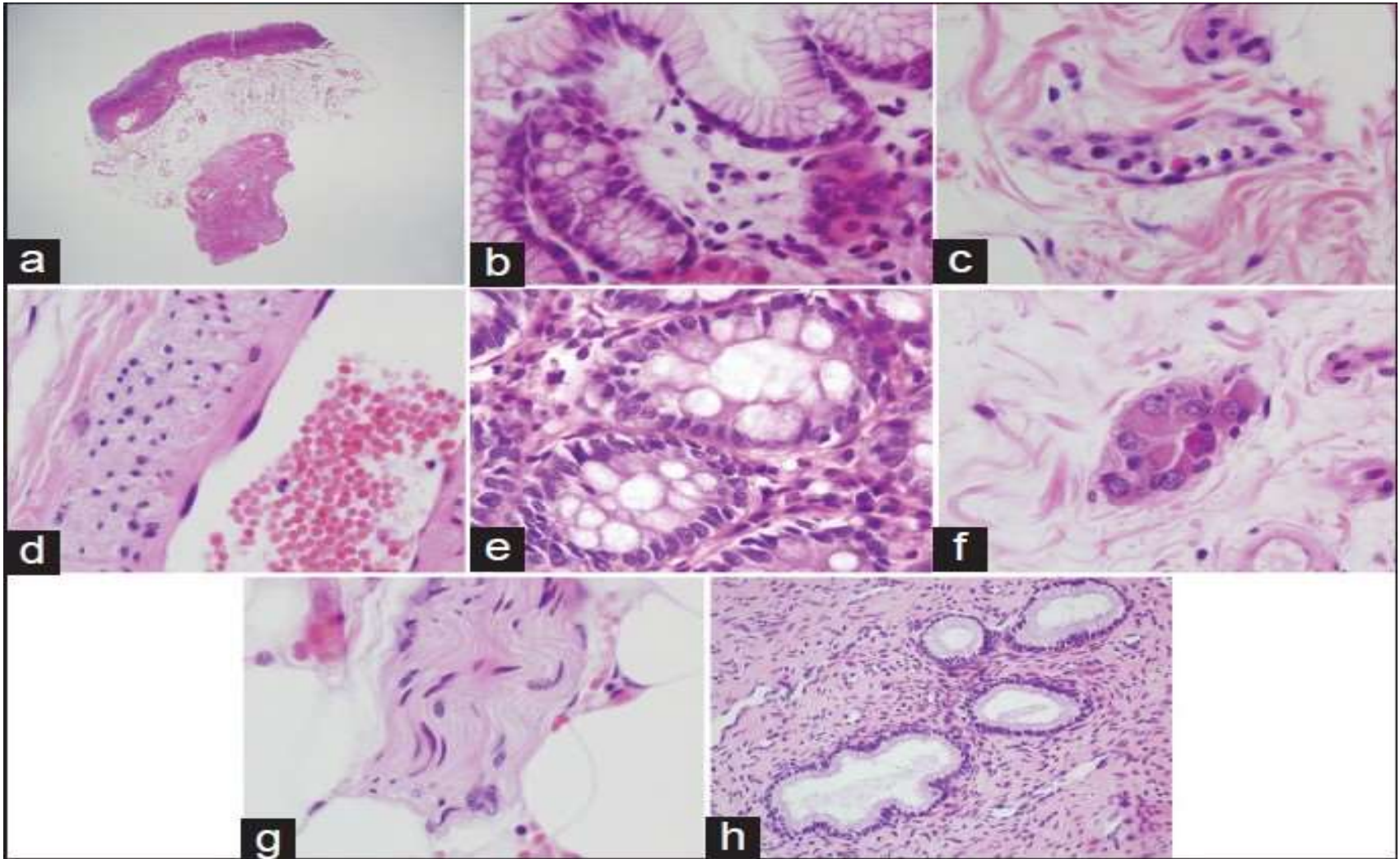
Molecular Investigations (Autoantibody panels)

- rheumatoid factor (for rheumatoid arthritis, less specific)
- anti-cyclic citrullinated peptide antibodies (anti-CCP) (for rheumatoid arthritis, more specific)
- LE cells (for systemic lupus erythematosus, less specific)
- anti-nuclear antibodies (ANA, for systemic lupus erythematosus, more specific)
- anti-double-stranded DNA antibody (anti-dsDNA) for systemic lupus erythematosus, confirmation of diagnosis of SLE in patients who have a positive test for ANA)
- anti-neutrophil cytoplasmic antibody (ANCA) - Wegener's, microvascular polyangiitis
- extractable nuclear antigens (ENA , for systemic lupus erythematosus)
- anti-phospholipid antibodies (APLA , for systemic lupus erythematosus)
- gene HLA-B27 (increased risk for development of spondyloarthropathy)

MSDs: Nerve and muscle tests

- Electromyography (neuromuscular junction)
- Nerve Conduction Studies (neuromuscular junction, useful for the diagnosis of peripheral nerve disorders)
 - If nerve conduction is slow, the cause may be a disorder that affects one nerve, or the cause may be a disorder that affects nerves throughout the body (diabetes)
 - If the muscle's response is progressively weaker after repeated stimulation, a problem with the neuromuscular junction (as occurs in myasthenia gravis) may be the cause

MSDs: Biopsy



MSDs: Imaging tests

- CT— Computed Tomography
- MRI— Magnetic Resonance Imaging
- Angiography
- PET— Radionuclide Scanning
- Doppler ultrasonography

MSDs: Dual-energy X-ray absorptiometry (DXA)



MSDs: Dual-energy X-ray absorptiometry (DXA)

The most accurate way to evaluate bone density at the lower spine, hip, wrist, or entire body, which is necessary when screening for or diagnosing osteopenia or osteoporosis



MSDs: Synovial Fluid Analysis

Synovial fluid should be examined in all pts with arthritis and whenever joint infection is probable:

- cell count and differential
- crystal examination for sodium urate and calcium phosphate dehydrate (CPPD)
- bacteria (culture and sensitivity, gram stain)
 - 500-1000 = non-inflammatory (OA)
 - 1000-10,000 = inflammatory

normal synovial fluid is colourless or straw-coloured and has <200 WBC/mm₃

MSDs: Synovial Fluid Analysis

Arthritis Type		White Cell Count	Crystal analysis	Glucose	Culture/Gram Stain
Septic Arthritis		>100,000	none	low	positive/positive
Inflammatory Arthritis					
	R.A.	>2,000	none	low	none
	Gout	>2,000	negatively birifringent	normal	none
	Pseudogout	>2,000	positively birifringent	normal	none
	Lyme	>2,000	none	normal	none*
Lupus		<5,000	none	normal	none
Osteoarthritis		<2,000	none	normal	none
*routine bacteriologic techniques cannot easily detect <i>Borrelia Burgdoferi</i>					

(c) 2005, Robert A. Kalish,

MSDs: Arthroscopy

During arthroscopy, doctors can take a piece of tissue (such as joint cartilage or the joint capsule) for analysis (biopsy), and, if necessary, do surgery to correct the condition



Marfan syndrome

Definition

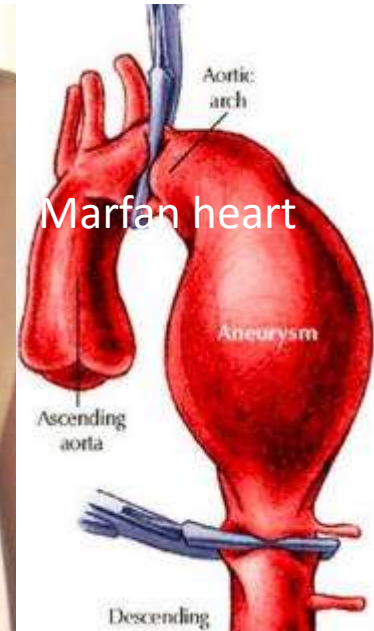
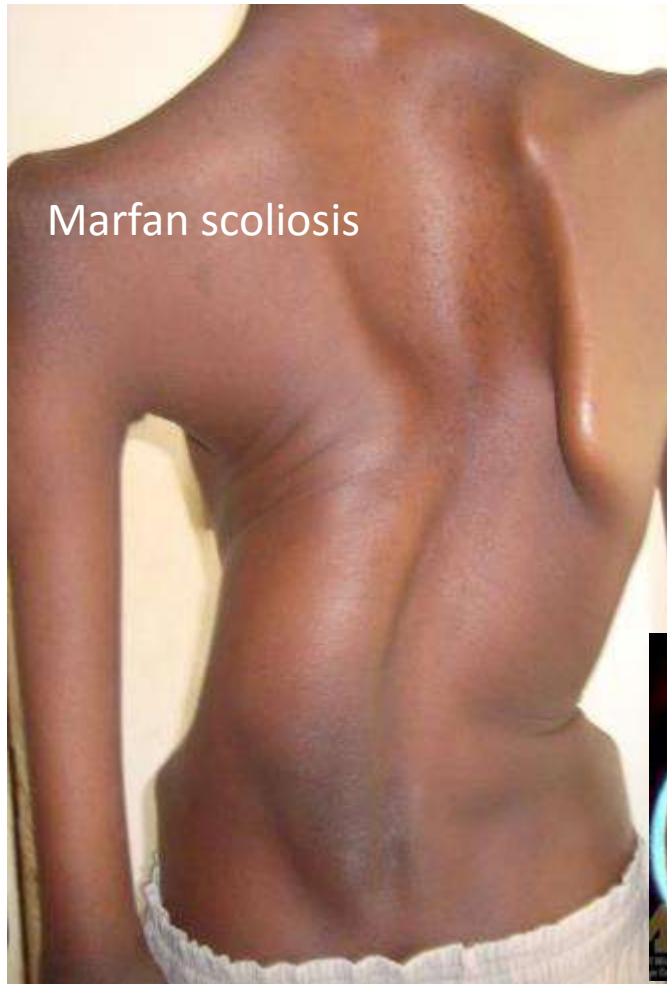
- An inherited genetic autosomal dominant disorder that affects the body's connective tissue and is caused by the misfolding of fibrillin-1, a glycoprotein which forms elastic fibers in connective tissue and contributes to cell signaling activity by binding to and sequestering transforming growth factor beta (TGF- β)
- Named after the French pediatrician Antoine Marfan, who described the condition in 1896

Marfan syndrome

Features may include

- Tall and slender build
- Disproportionately long arms, legs, fingers and toes
- A breastbone that protrudes outward or dips inward
- A high, arched palate and crowded teeth
- Heart murmurs
- Extreme nearsightedness
- An abnormally curved spine
- Flat feet

Marfan syndrome



Marfan syndrome

Diagnosis: in the absence of family history

- Aortic Root Dilatation Z score ≥ 2 AND Ectopia Lentis = Marfan syndrome
- Aortic Root Dilatation Z score ≥ 2 AND FBN1 = Marfan syndrome
- Aortic Root Dilatation Z score ≥ 2 AND Systemic Score ≥ 7 pts = Marfan syndrome
- Ectopia lentis AND FBN1 with known Aortic Root Dilatation = Marfan syndrome

Marfan syndrome

Diagnosis: in the presence of family history

- Ectopia lentis AND Family History of Marfan syndrome (as defined above) = Marfan syndrome
- A systemic score ≥ 7 points AND Family History of Marfan syndrome (as defined above) = Marfan syndrome
- Aortic Root Dilatation Z score ≥ 2 above 20 yrs. old, ≥ 3 below 20 yrs. old) + Family History of Marfan syndrome (as defined above) = Marfan syndrome

Marfan syndrome

Complications

- Cardiovascular: aortic aneurysm, aortic dissection, valve malformations
- Eye: lens dislocation, retinal problems, early-onset glaucoma or cataracts
- Skeletal: abnormal curves in the spine, such as scoliosis; foot pain; and low back pain are common with Marfan syndrome
- Pulmonary: pneumothorax , sleep apnea, obstructive lung disease

Marfan syndrome

The Mystery of Akhenaten

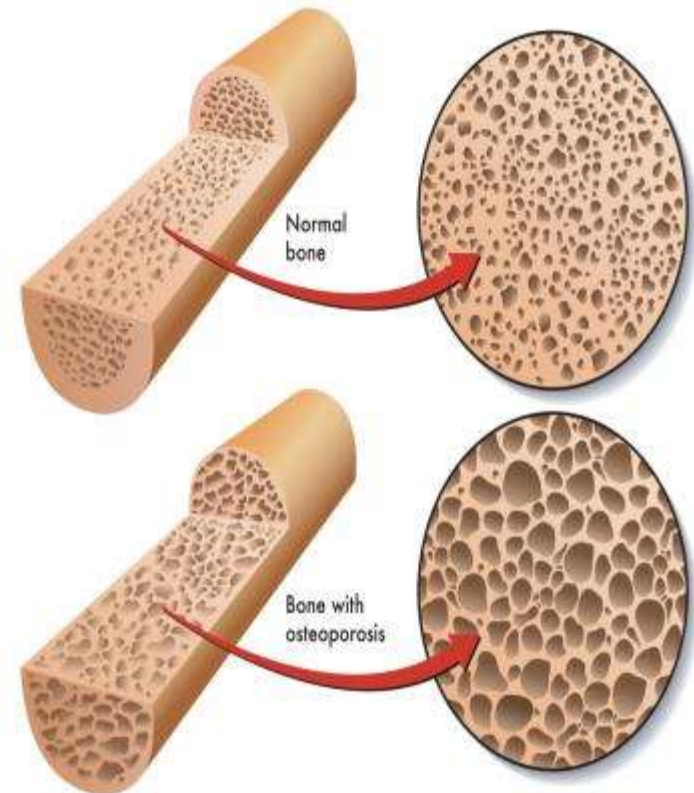
- Akhenaten is one of the most famous pharaohs of ancient Egypt
- In sculptures Akhenaten is shown as having a long, slender neck, a long face with a sharp chin, narrow, almond-shaped eyes, full lips, long arms and fingers, rounded thighs and buttocks, a soft belly, and enlarged breasts
- The most recently suggested possibility for Akhenaten's supposed pathology is a Marfan's Syndrome



Osteoporosis

Definition

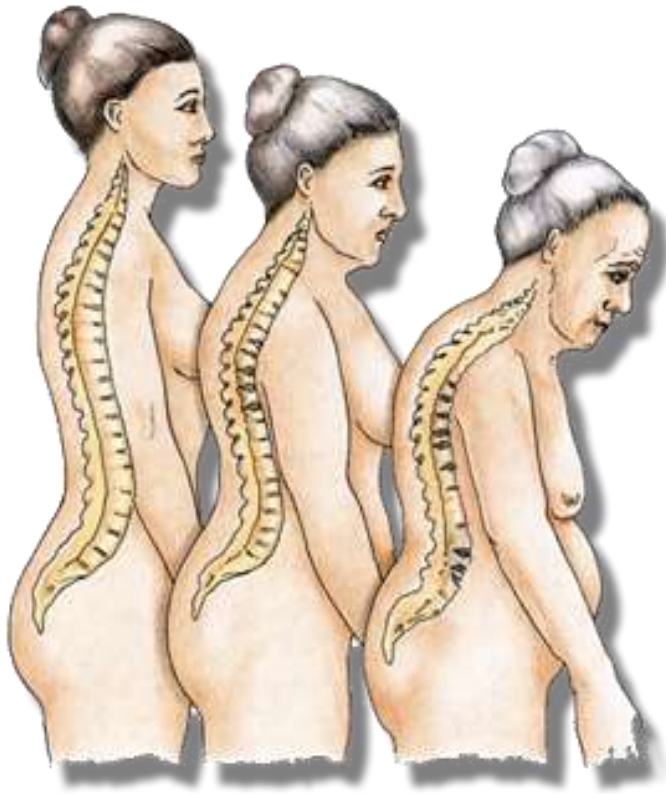
- Osteoporosis (porous bones) is characterized by a decrease in bone mass and density which can lead to an increased risk of fracture
- Osteoporosis is a silent disease!



Osteoporosis

Risk factors

- Getting older
- Being small and thin
- Having a family history of osteoporosis
- Taking certain medicines
- Being a white or Asian woman
- Having osteopenia, which is low bone density



Osteoporosis

Criteria

- Osteoporosis is defined by the World Health Organization (WHO) as a bone mineral density of 2.5 standard deviations or more below the mean peak bone mass (average of young, healthy adults) as measured by dual-energy X-ray absorptiometry

Osteoporosis

Types

- Primary type 1 (in women after menopause)
- Primary type 2 (senile osteoporosis occurs after age 75 and is seen in both females and males at a ratio of 2:1)
- Secondary (chronic predisposing medical problems or disease (cancer with metastasis to the bone, multiple myeloma, Cushing's disease) or prolonged use of medications such as glucocorticoids)

Osteoporosis

Symptoms

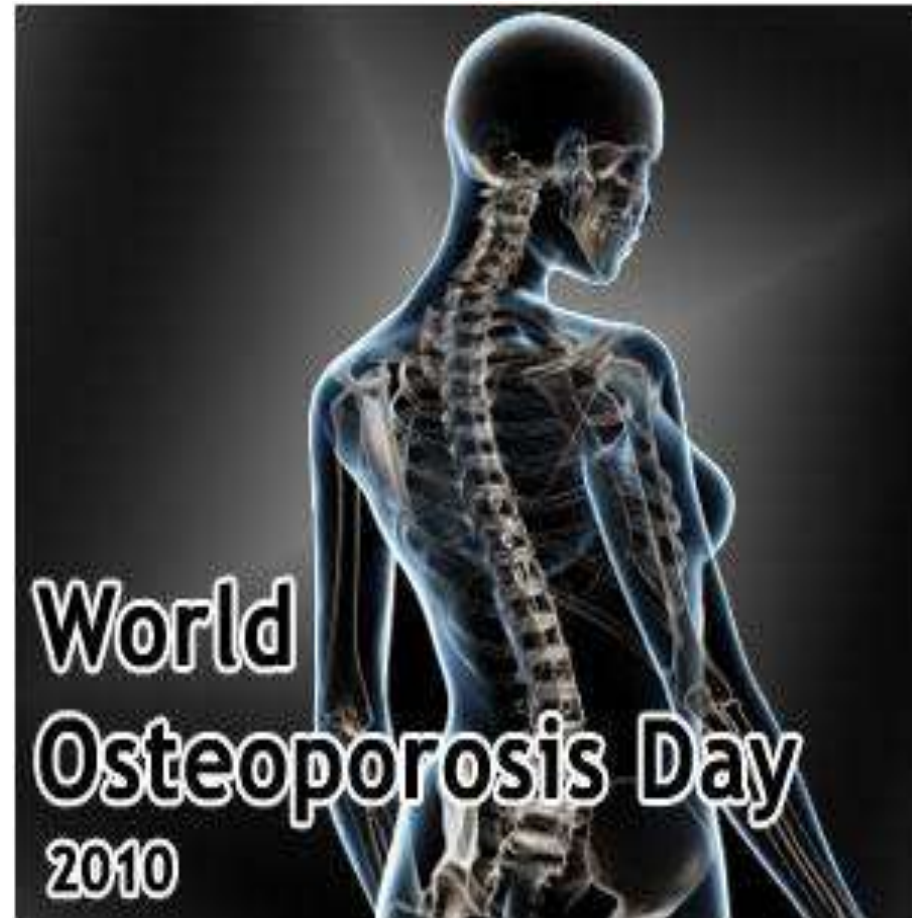
- No symptoms
- The main consequence is the increased risk of bone fractures
- Fractures occur in situations where healthy people would not normally break a bone
- Typical fragility fractures occur in the vertebral column, rib, hip and wrist



Osteoporosis

The WHO Fracture Risk Assessment Tool (FRAX[®])

- Postmenopausal women or men age 50 and older
- People with low bone density (osteopenia)
- People who have not taken an osteoporosis medicine



Osteoporosis

Laboratory Tests

- Blood calcium levels
- 24-hour urine calcium measurement
- Thyroid function tests
- Parathyroid hormone levels
- Testosterone levels in men
- 25-hydroxyvitamin D test to determine whether the body has enough vitamin D
- Biochemical marker tests, such as NTX and CTX

Osteoporosis

Dual-energy X-ray: osteoporosis (WHO guidelines) is diagnosed when the bone mineral density is less than 2.5 standard deviations below that of a young (30–40-year-old), healthy adult women reference population (T-score)

Category	T-score range	% young women
Normal	T-score ≥ -1.0	85%
Osteopenia	$-2.5 < \text{T-score} < -1.0$	14%
Osteoporosis	T-score ≤ -2.5	0.6%
Severe osteoporosis	T-score ≤ -2.5 with fragility fracture	

Osteoporosis

Conventional radiography (in conjunction with CT or MRI)

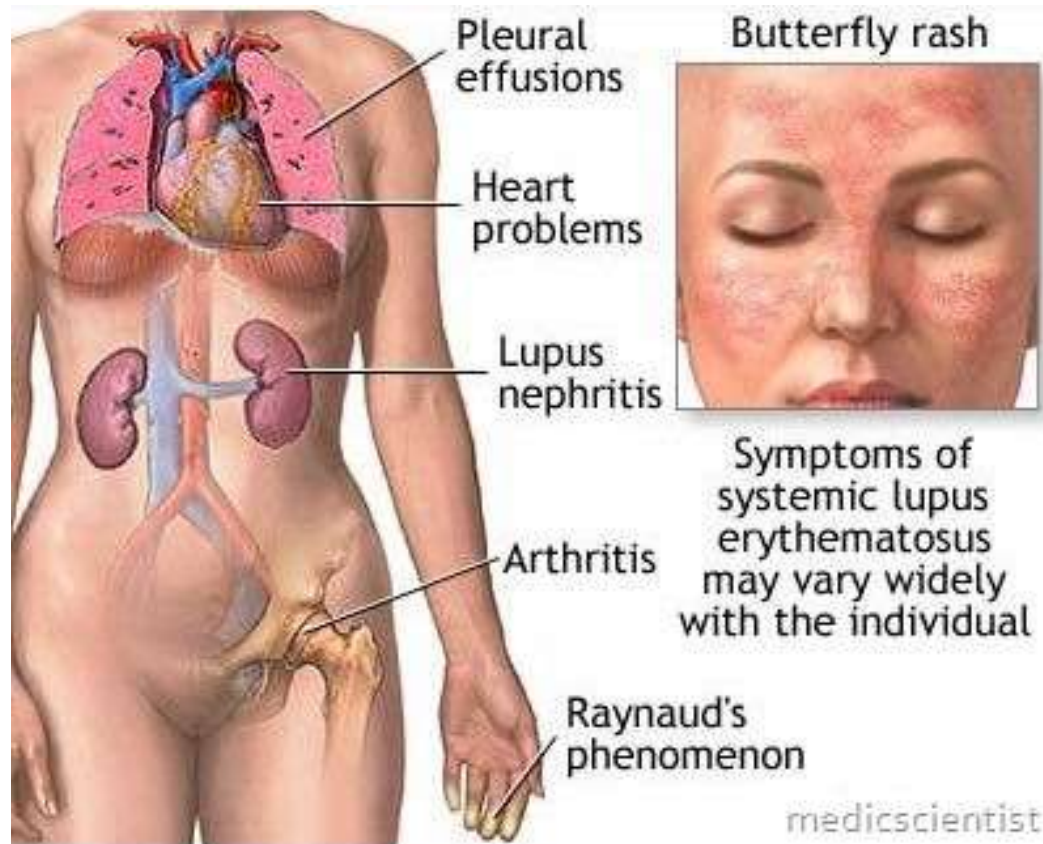
- detecting complications of osteopenia (reduced bone mass; preosteoporosis), such as fractures
- differential diagnosis of osteopenia
- follow-up examinations in specific clinical settings, such as soft tissue calcifications, secondary hyperparathyroidism, or osteomalacia in renal osteodystrophy

Systemic Lupus Erythematosus

Definition

- Systemic lupus erythematosus (SLE) is a chronic systemic autoimmune connective tissue disease that can affect almost any organ system, including joints, skin, kidneys, blood cells, brain, heart and lungs, has protean manifestations and follows a relapsing and remitting course, ranging from indolent to fulminant
- More than 90% of cases of SLE occur in women, frequently starting at childbearing age

Systemic Lupus Erythematosus



Systemic Lupus Erythematosus

Causes

- Genetics: no single causal gene has been identified, multiple genes appear to influence a person's chance of developing lupus when triggered by environmental factors, HLA class I, class II, and class III genes are associated with SLE, but only classes I and II contribute independently to increased risk of SLE
- Drug reactions: drug-induced SLE is a (generally) reversible condition that usually occurs in people being treated for a long-term illness, more than 38 medications can cause this condition (procainamide, isoniazid, hydralazine, quinidine, and phenytoin)

Systemic Lupus Erythematosus



Systemic Lupus Erythematosus

Signs and symptoms

- Constitutional (eg, fatigue, fever, arthralgia, weight changes)
- Musculoskeletal (eg, arthralgia, arthropathy, myalgia, frank arthritis, avascular necrosis)
- Cutaneous (eg, malar rash, photosensitivity, discoid lupus)
- Renal (eg, acute or chronic renal failure, acute nephritic disease)
- Neuropsychiatric (eg, seizure, psychosis)
- Pulmonary (eg, pleurisy, pleural effusion, pneumonitis, pulmonary hypertension, interstitial lung disease)
- Gastrointestinal (eg, nausea, dyspepsia, abdominal pain)
- Cardiac (eg, pericarditis, myocarditis)
- Hematologic (eg, multiple cytopenias such as leukopenia, lymphopenia, anemia, or thrombocytopenia)

Systemic Lupus Erythematosus



Systemic Lupus Erythematosus

Other cutaneous manifestations

- Raynaud phenomenon
- Livedo reticularis
- Panniculitis (lupus profundus)
- Bullous lesions
- Vasculitic purpura
- Telangiectasias
- Urticaria

Systemic Lupus Erythematosus



Systemic Lupus Erythematosus

Laboratory tests

- CBC (complete blood count) with differential
- Serum creatinine
- Urinalysis with microscopy
- ESR or CRP results
- Complement levels
- Liver function tests
- Creatine kinase assay
- Spot protein/spot creatinine ratio
- Autoantibody tests
- Electrolytes
- Liver enzymes

Systemic Lupus Erythematosus



Bullous lesions

Systemic Lupus Erythematosus

Lupus band test

- Skin biopsy, with direct immunofluorescence
- The minimum criteria for positivity are:
- In sun-exposed skin: presence of a band of deposits of IgM along the epidermal basement membrane in 50% of the biopsy, intermediate (2+) intensity or more
- In sun-protected skin : presence of interrupted (i.e. less than 50%) deposits of IgM along the epidermal basement membrane, intermediate (2+) intensity or more

Systemic Lupus Erythematosus



Vasculitic purpura

Systemic Lupus Erythematosus

Imaging studies

- Joint radiography
- Chest radiography and chest CT scanning
- Echocardiography
- Brain MRI/ MRA
- Cardiac MRI

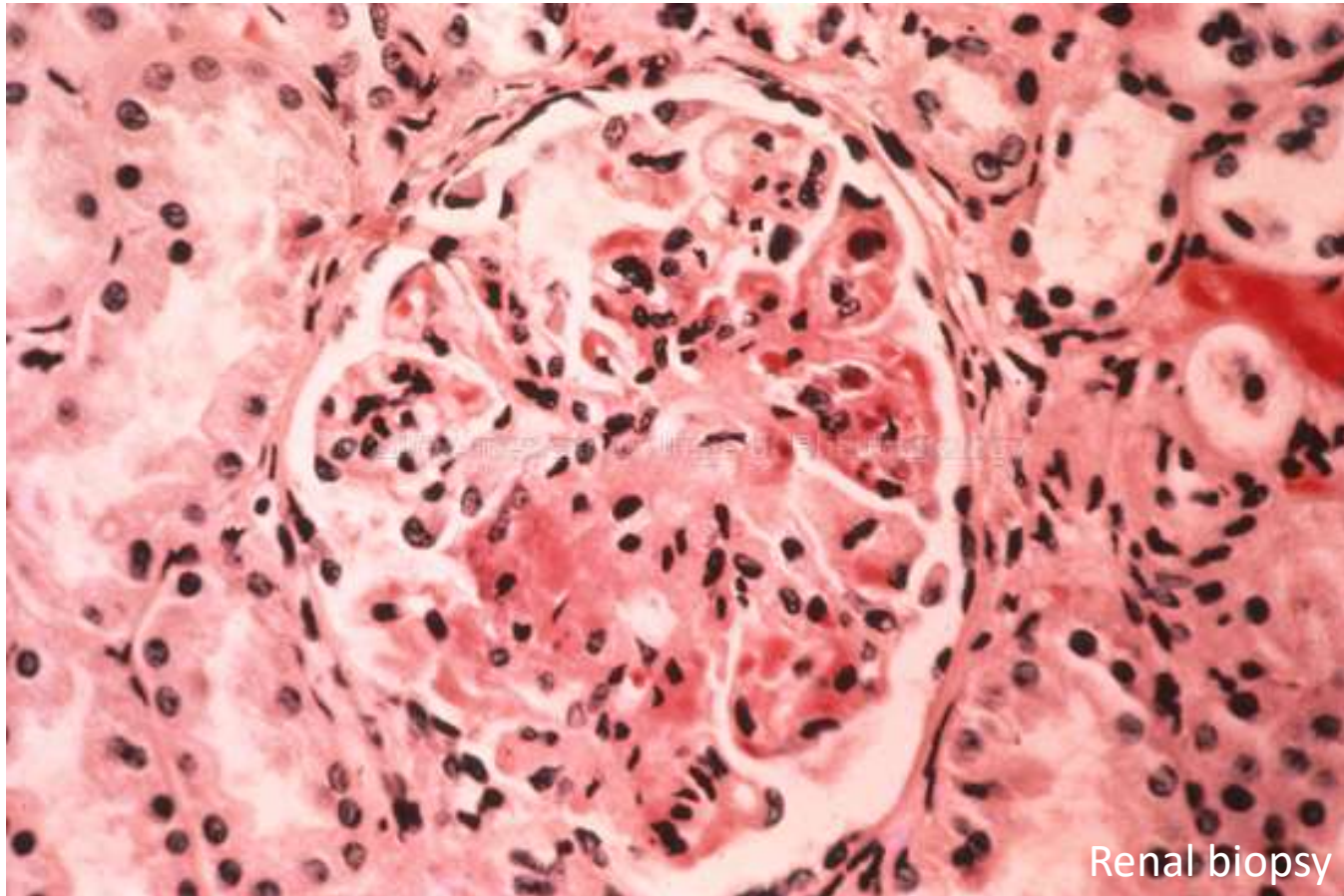
Procedures

- Arthrocentesis
- Lumbar puncture
- Renal biopsy

Systemic Lupus Erythematosus



Systemic Lupus Erythematosus



Systemic Lupus Erythematosus

American College of Rheumatology (ACR) criteria

- Serositis
- Oral ulcers
- Arthritis
- Photosensitivity
- Blood disorders
- Renal involvement
- Antinuclear antibodies
- Immunologic phenomena (eg, dsDNA; anti-Smith [Sm] antibodies)
- Neurologic disorder
- Malar rash
- Discoid rash

Systemic Lupus Erythematosus

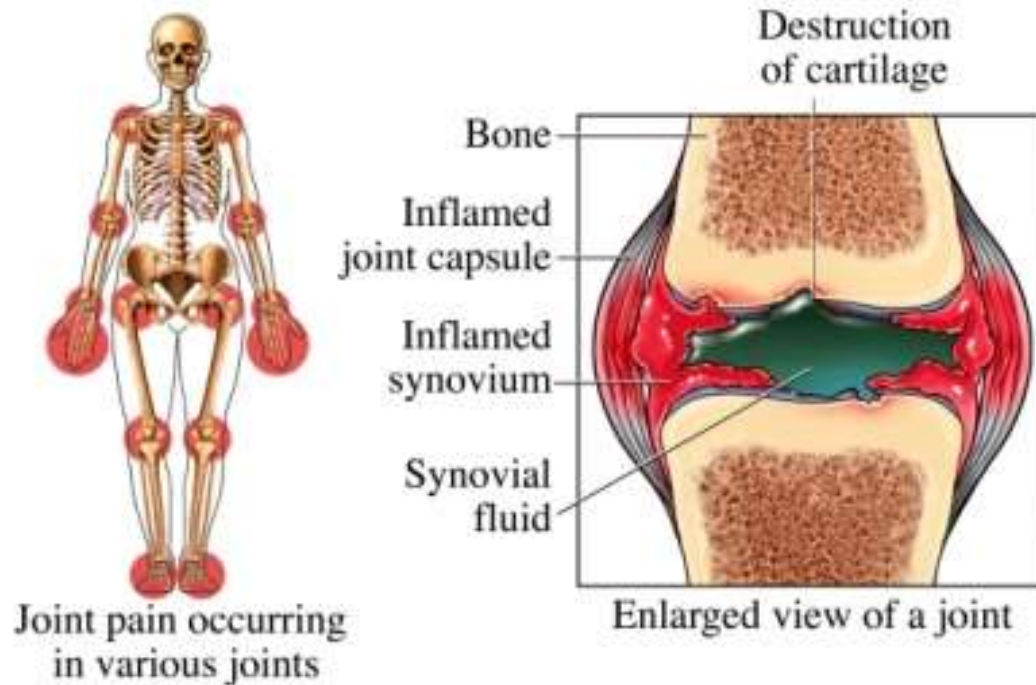


Rheumatoid Arthritis

Definition

- A chronic systemic inflammatory disorder that typically affects the small joints of hands and feet, causing a painful swelling that eventually results in bone erosion and joint deformity, which lead to loss of function, and can affect multiple organs of the body (the lungs, heart, eyes atc.)

Rheumatoid Arthritis

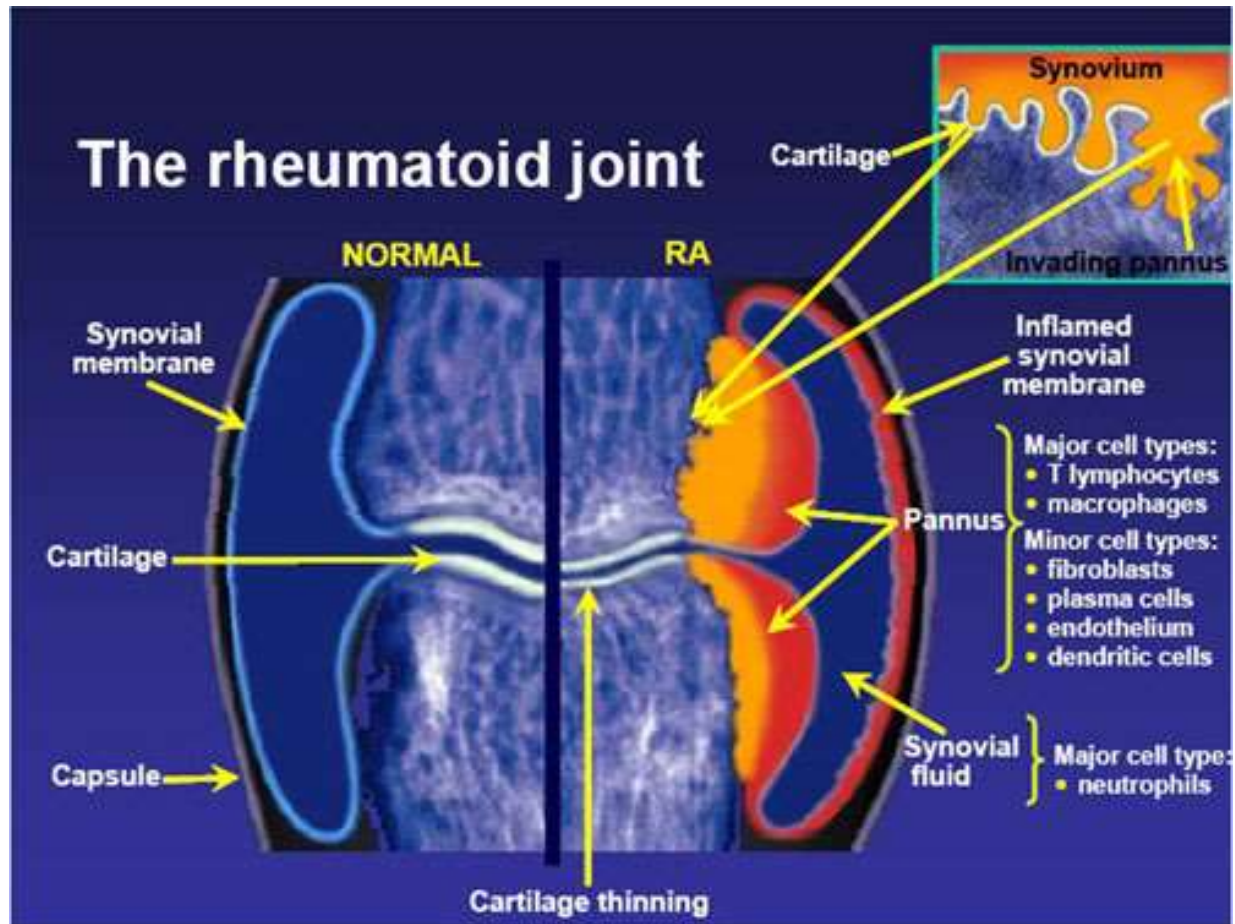


Rheumatoid Arthritis

Causes

- Specific agent or agents are not yet known
- Half of the risk is believed to be genetic (the inherited tissue type major histocompatibility complex (MHC) antigen HLA-DRB1 (most specifically the shared epitope alleles, including *0401 and *0404), and the genes PTPN22 and PADI4—hence family history is an important risk factor)
- Infectious agents, such as viruses and bacteria, may trigger RA in people with an inherited tendency to develop the disease

Rheumatoid Arthritis



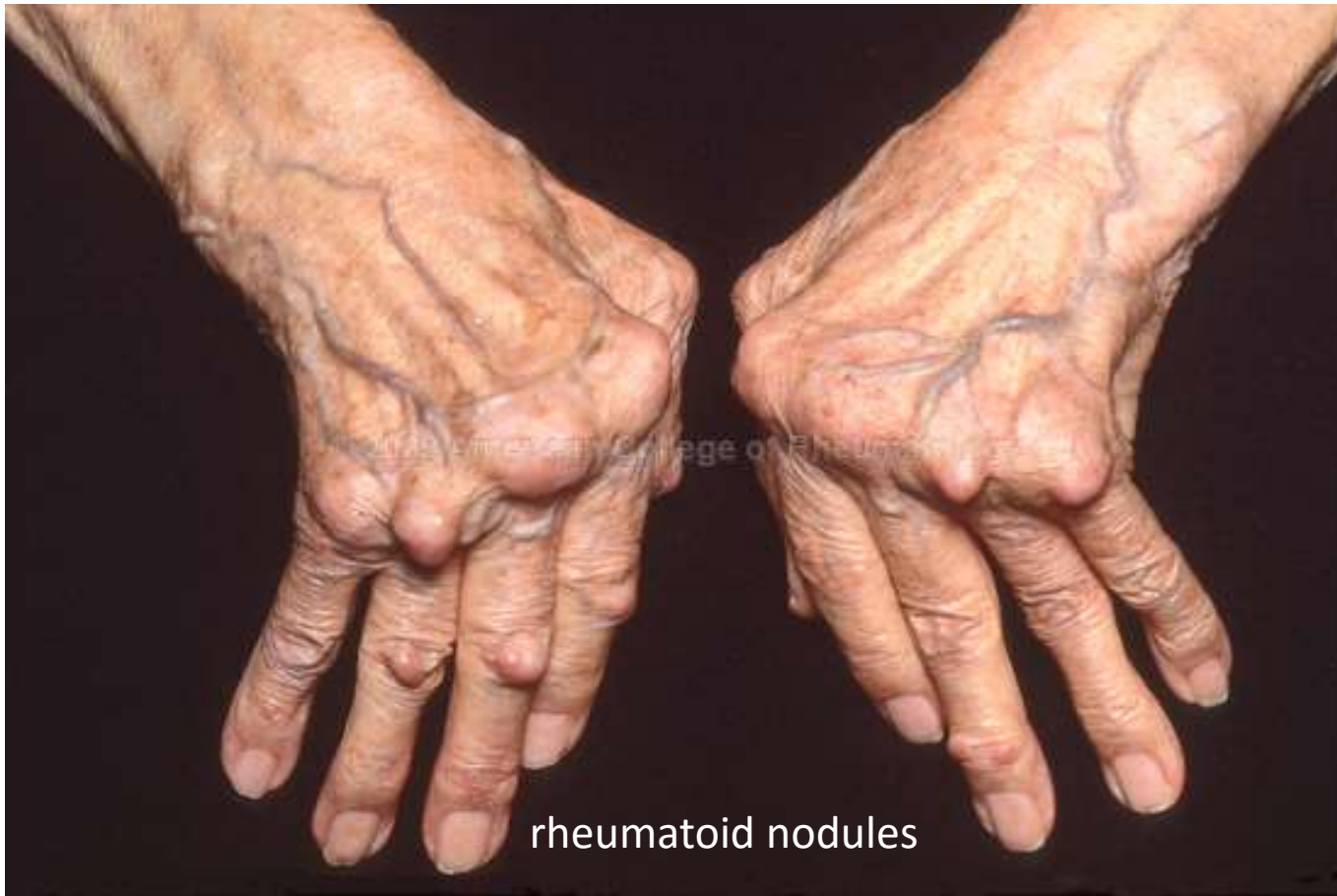
Rheumatoid Arthritis

Symptoms that affect the joints and the skin

- Tender, warm, swollen joints
- Morning stiffness that may last for hours
- Pain
- Firm bumps of tissue under the skin on arms (rheumatoid nodules)

Early rheumatoid arthritis (RA) tends to affect smaller joints first. As the RA, symptoms spread to the wrists, knees, ankles, elbows, hips and shoulders. In most cases, symptoms occur in the same joints on both sides of the body.

Rheumatoid Arthritis



rheumatoid nodules

Rheumatoid Arthritis

The most commonly affected joints

- The proximal interphalangeal (PIP) and metacarpophalangeal (MCP) joints of the hands (middle and base joints of the finger)
- The wrists, especially the ulnar-styloid articulation
- The shoulders
- Elbows
- Knees
- Ankles
- Metatarsophalangeal (MTP) joints (in the toes)

Rheumatoid Arthritis

Stages of RA

Early RA



Intermediate RA



Late RA

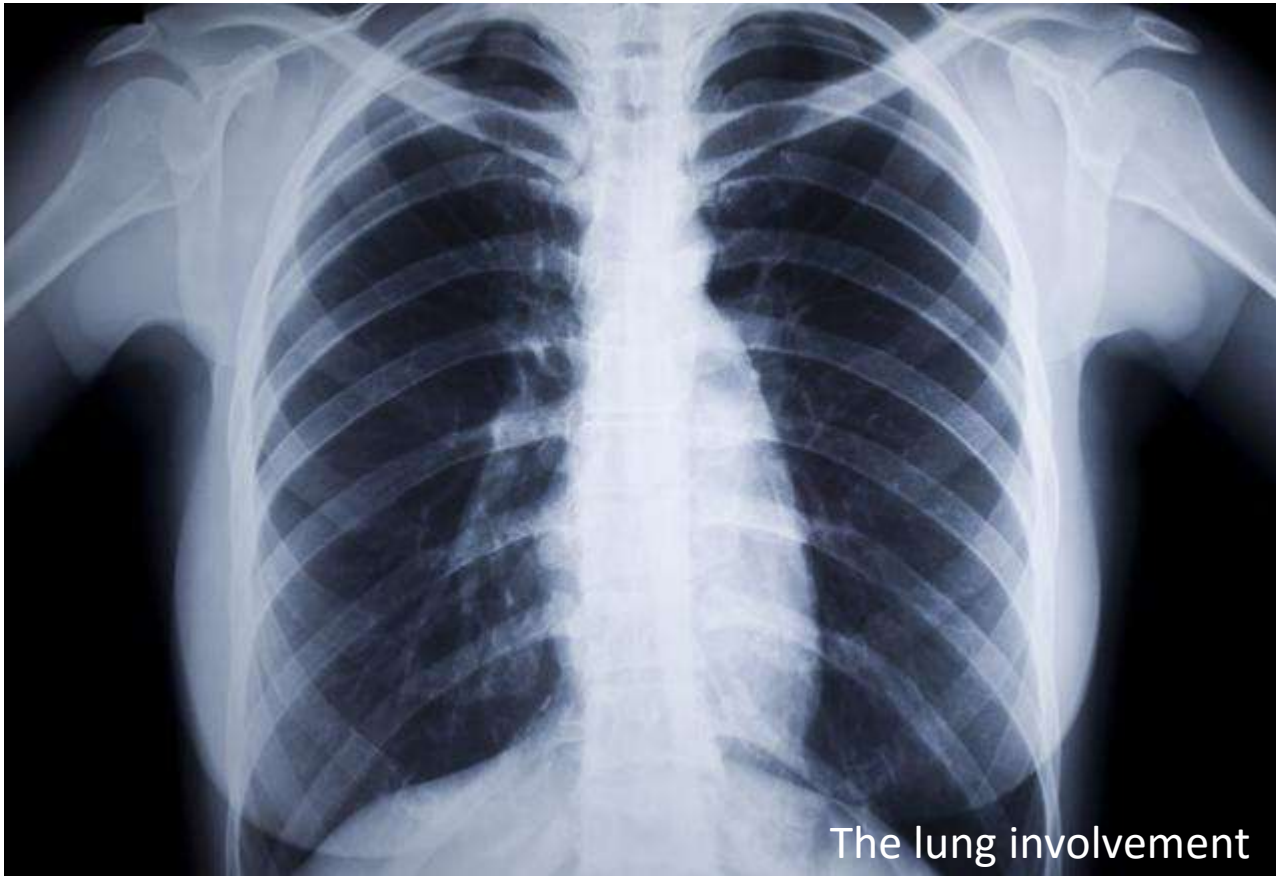


Rheumatoid Arthritis

Symptoms that affect the entire body

- Fatigue
- Malaise (feeling ill)
- Loss of appetite, which can lead to weight loss
- Muscle aches
- The lung involvement
- The heart involvement
- The tear glands, and the salivary glands involvement
- Affect a joint in voice box or larynx (cricothyroid joint)
- Anemia: approximately 80% of patients are anemic

Rheumatoid Arthritis



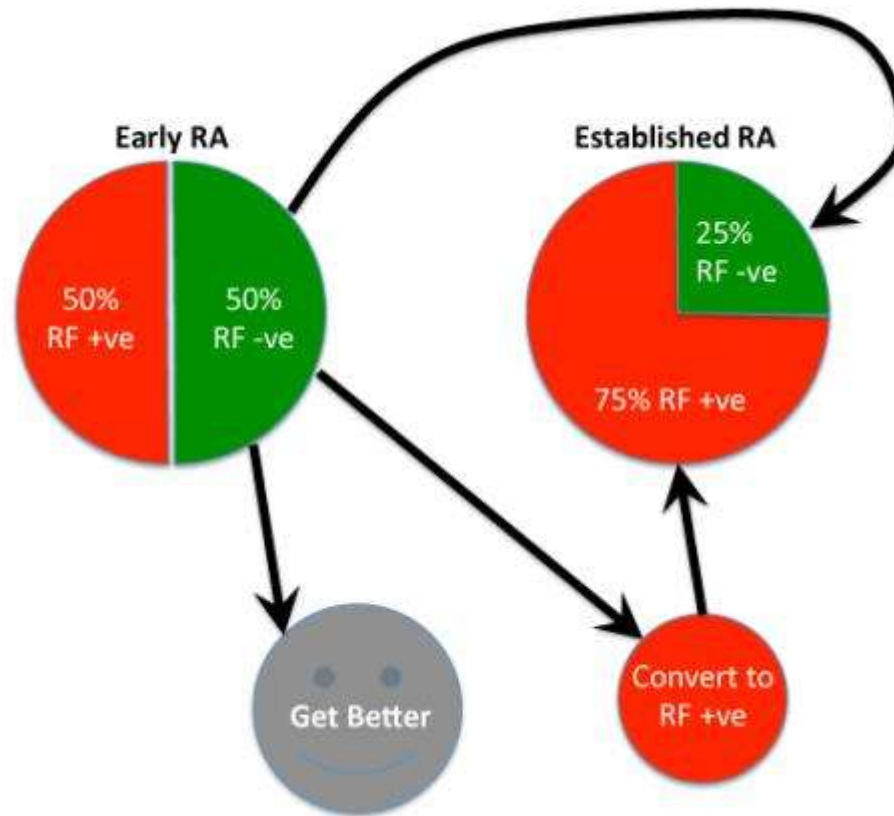
The lung involvement

Rheumatoid Arthritis

Blood tests

- Rheumatoid factor (RF)
- Anti-citrullinated protein antibody (ACPA)
- Anti-cyclic citrullinated peptide (anti-CCP)
- Antibodies against mutated citrullinated Vimentin (Anti-MCV)
- A serological point-of-care test (POCT) combines the detection of rheumatoid factor and anti-MCV
- Erythrocyte sedimentation rate (ESR)
- C-reactive protein
- Full blood count
- Kidney function
- Liver enzymes

Rheumatoid Arthritis



The name “rheumatoid factor” is a bit misleading - in patients in the very early stages of rheumatoid arthritis, only about half (50%) will be positive for it

Rheumatoid Arthritis

Imaging

- X-rays
- Magnetic resonance imaging (MRI)
- Ultrasound (high-frequency transducers > 10 MHz), color Doppler and power Doppler ultrasound

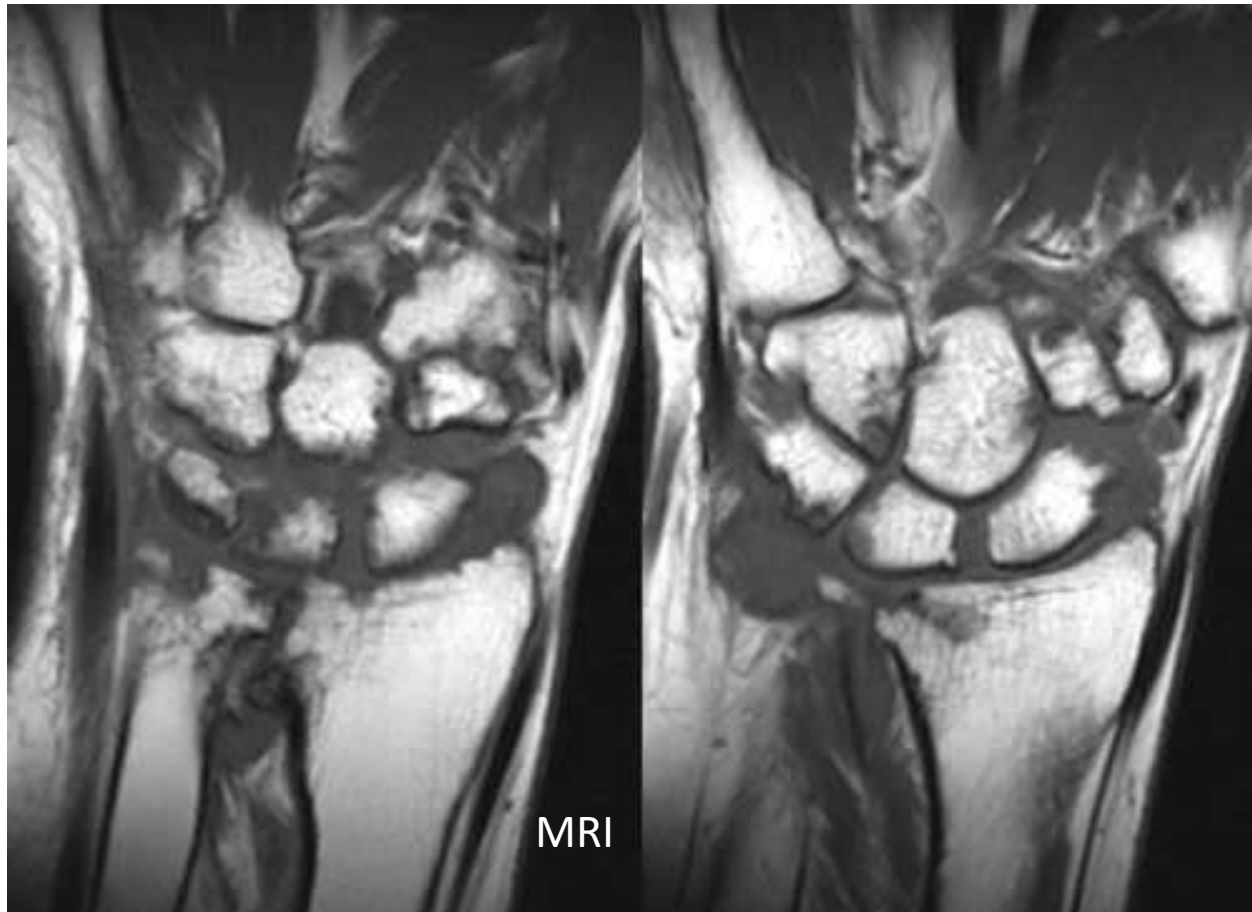
Rheumatoid Arthritis



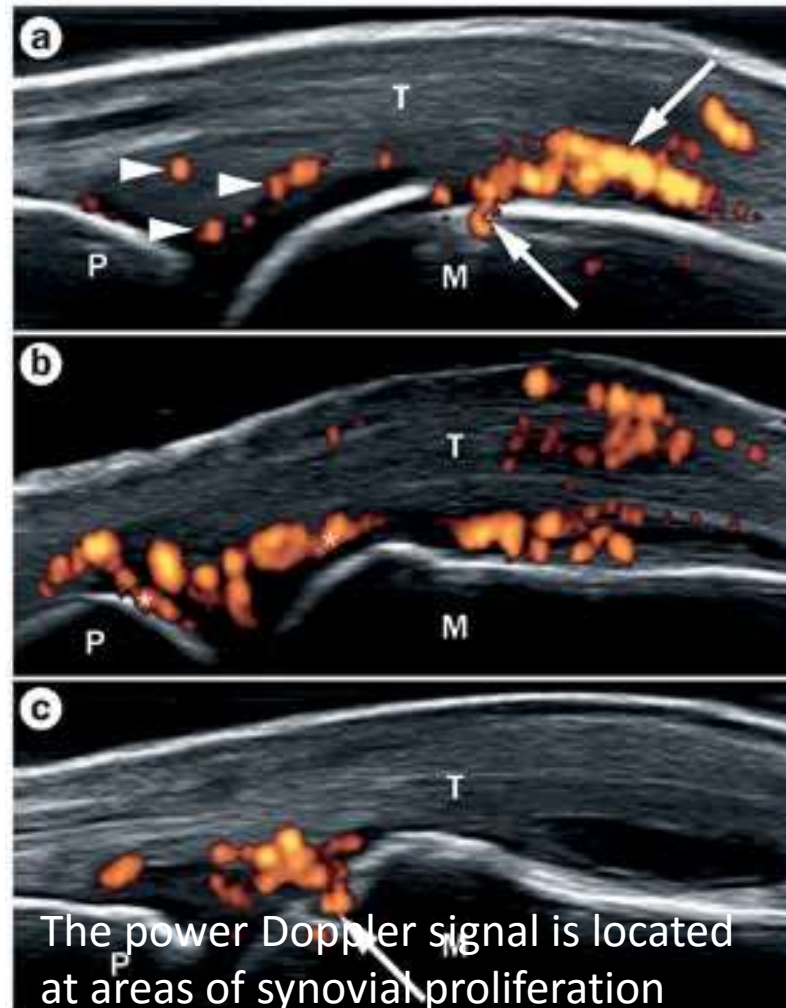
Rheumatoid Arthritis



Rheumatoid Arthritis



Rheumatoid Arthritis



Rheumatoid Arthritis

The 2010 ACR / EULAR Rheumatoid Arthritis Classification Criteria

- Joint involvement: 1 large joint - 0 points, 2–10 large joints - 1 point, 1–3 small joints - 2 points, 4–10 small joints - 3 points, more than 10 joints - 5 points
- Serological parameters (rheumatoid factor – RF, anti-citrullinated protein antibody - ACPA): negative RF *and* negative ACPA - 0 points, low-positive RF *or* low-positive ACPA - 2 points, high-positive RF *or* high-positive ACPA - 3 points
- Acute phase reactants: elevated erythrocyte sedimentation rate (ERS) - 1 point, or elevated c-reactive protein (CRP) - 1 point for symptoms lasting six weeks or longer

A score of 6 or greater unequivocally classifies a person with a diagnosis of rheumatoid arthritis

Rheumatoid Arthritis

Clinical practice criteria

- Two or more swollen joints
- Morning stiffness lasting more than one hour for at least six weeks
- The detection of rheumatoid factors or autoantibodies against ACPA such as autoantibodies to mutated citrullinated vimentin can confirm the suspicion of RA
- A negative autoantibody result does not exclude a diagnosis of RA

Lecture 17

Syndromes of the blood system diseases

Plan of the lecture

- Blood
- Spectrum of Blood Disorders
- Blood System' Methods of Examination
- Blood System' Signs and Symptoms
- Glossary of Terms referred to Endocrine Diseases and Metabolic Disorders

Hematopoiesis

Myeloid tissue

Bone marrow

Erythrocytes

Platelets

Granulocytes

Monocytes

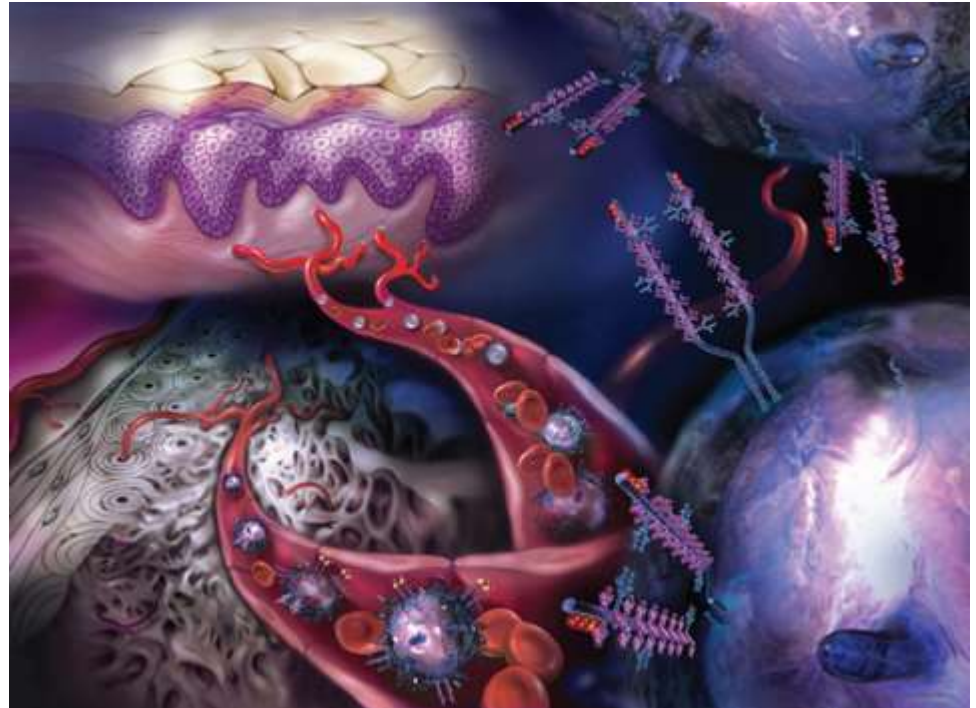
Lymphocytes

Lymphoid tissue

Thymus

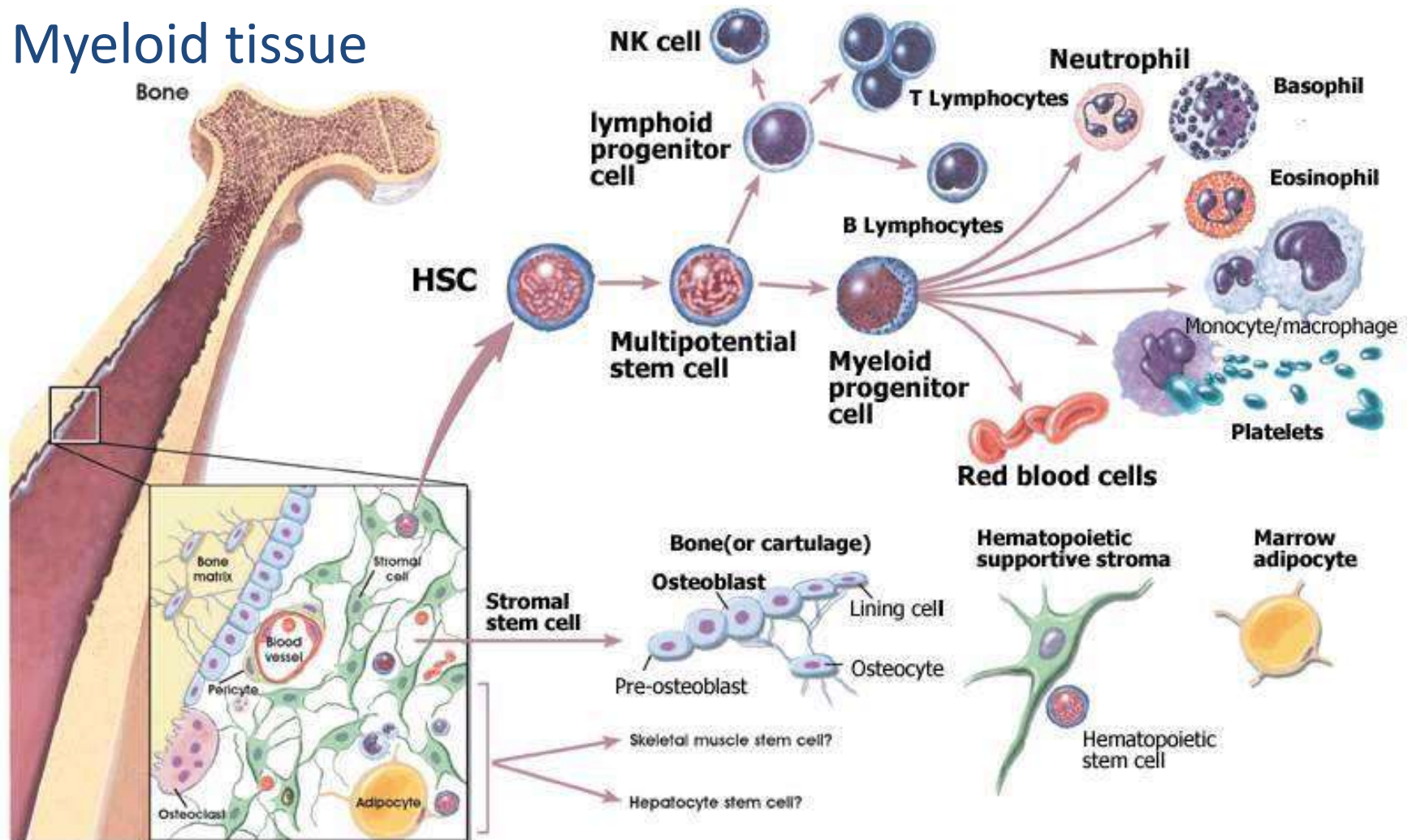
Lymph nodes

Spleen



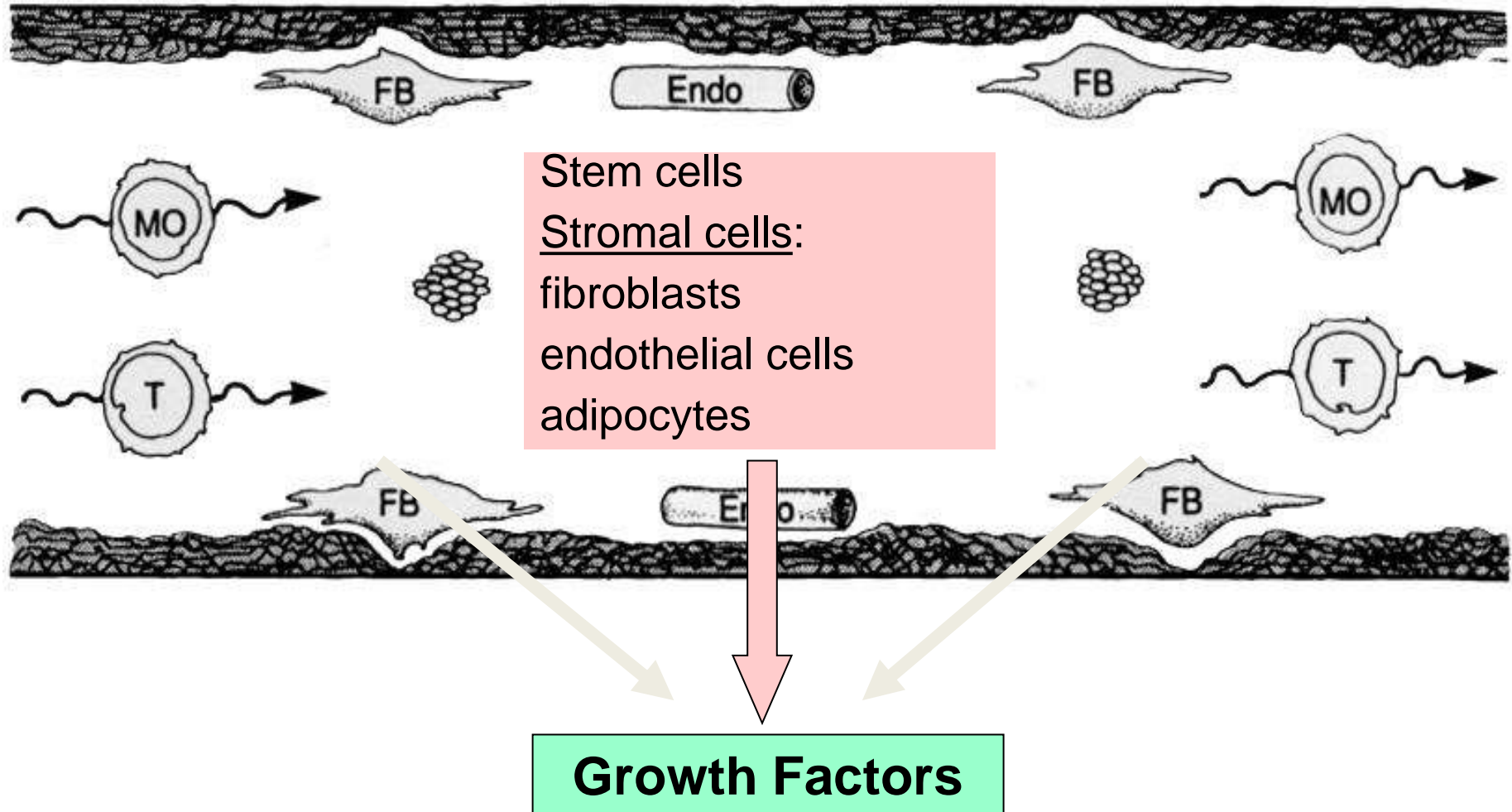
Hematopoiesis

Myeloid tissue



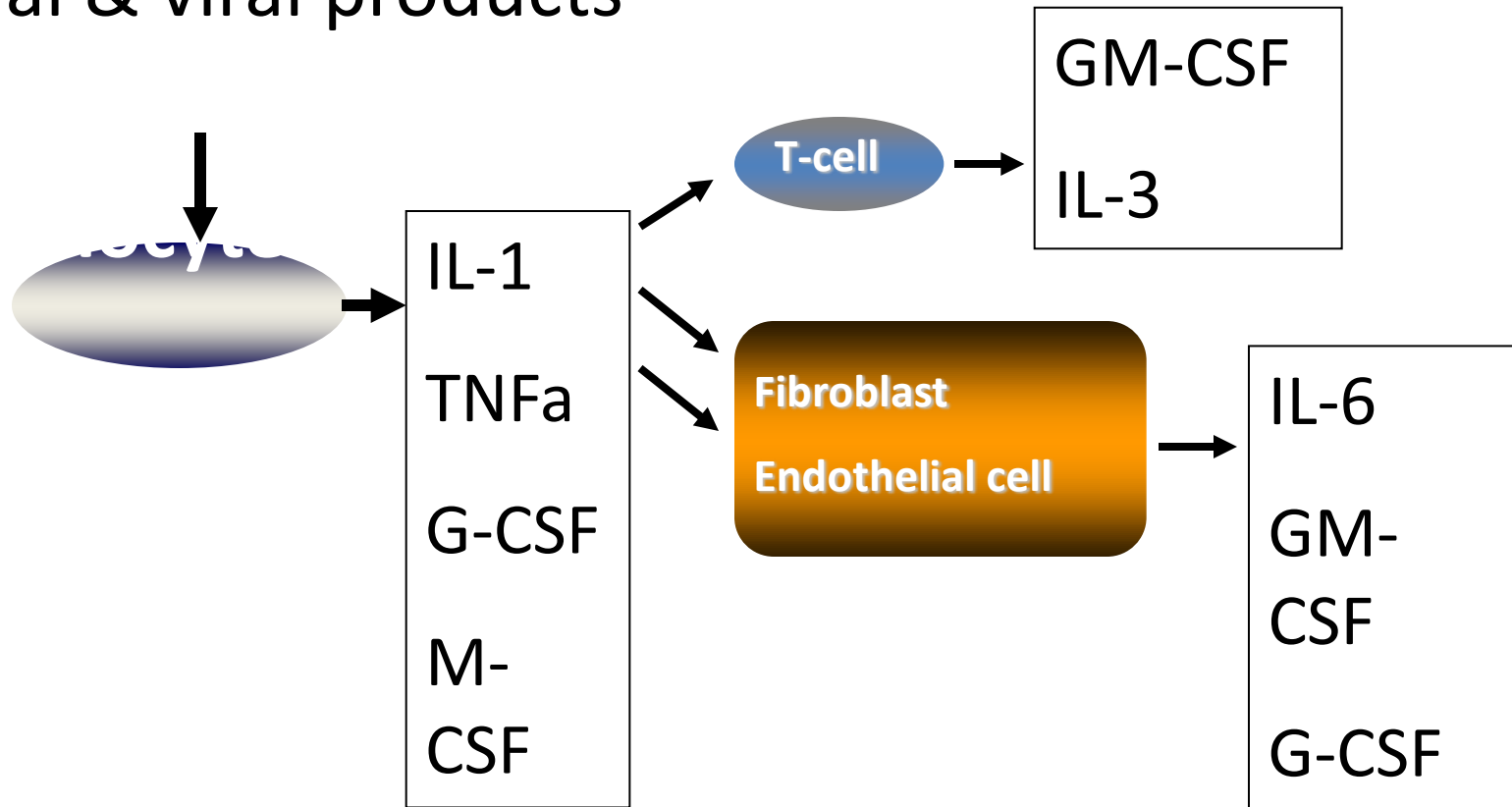
©2001 Terese Winslow. Lydia Kibiuk

Hematopoietic Microenvironment

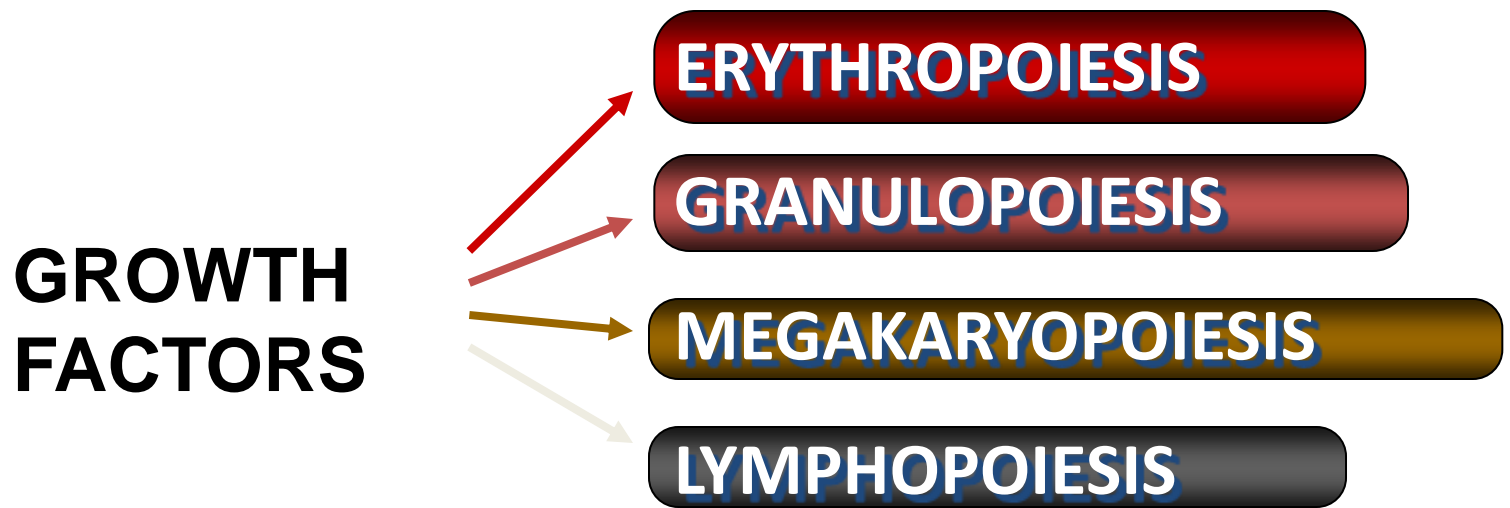


Hematopoietic Growth Factors

Bacterial & viral products



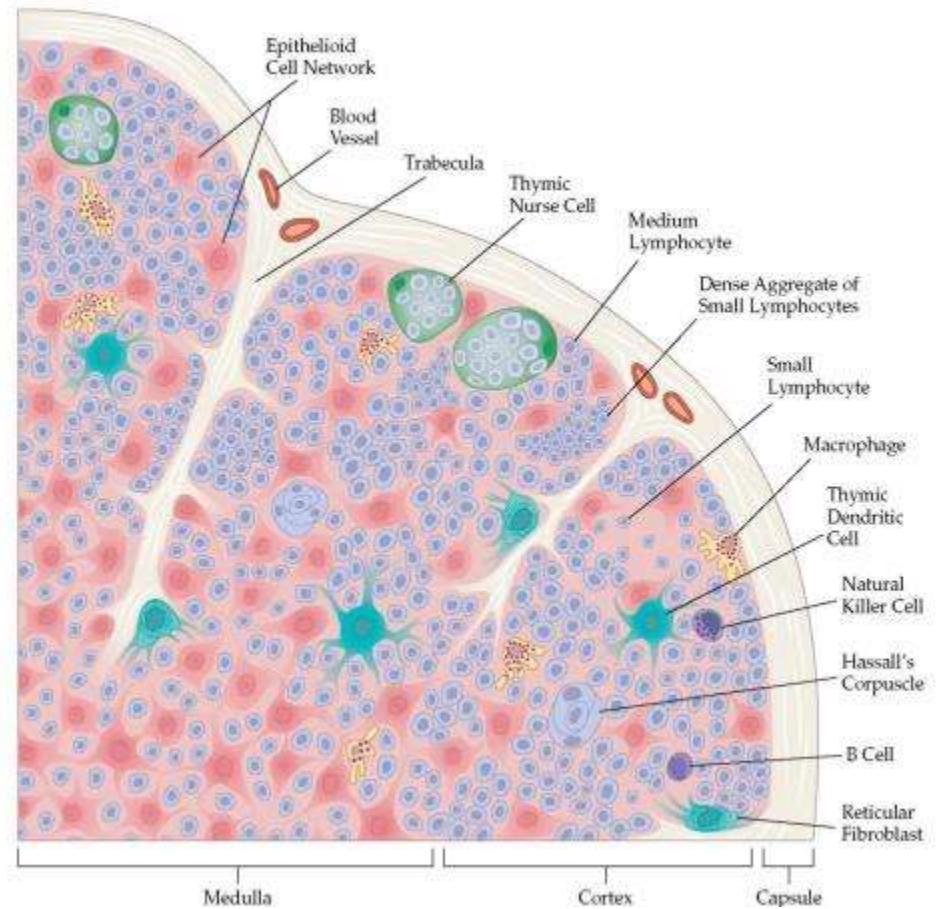
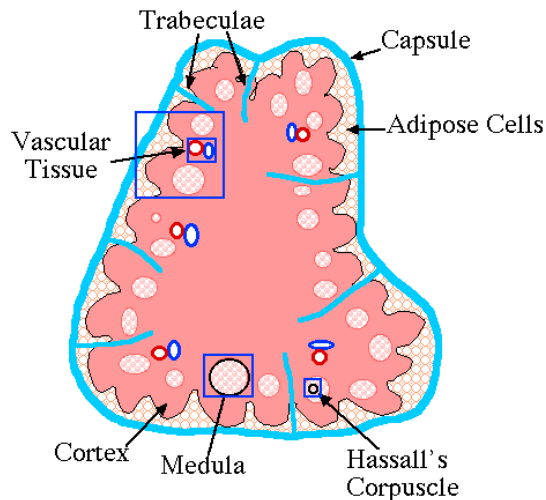
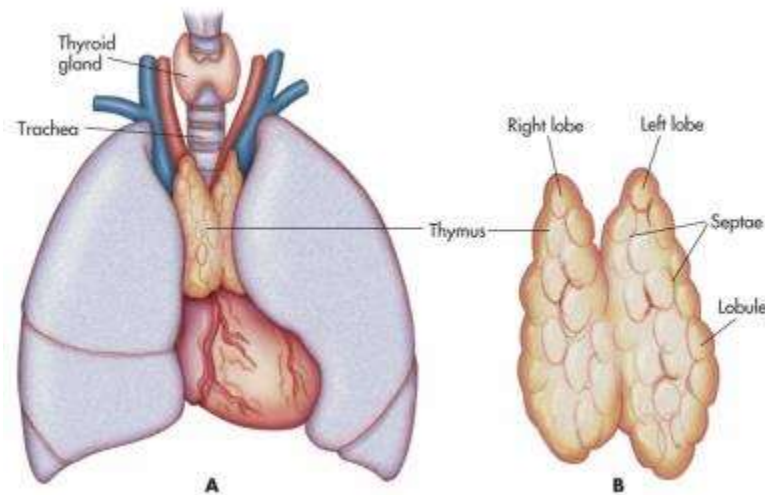
Hematopoiesis



Generation of each specific lineage of mature blood cells is regulated by a specific set of hematopoietic growth factors

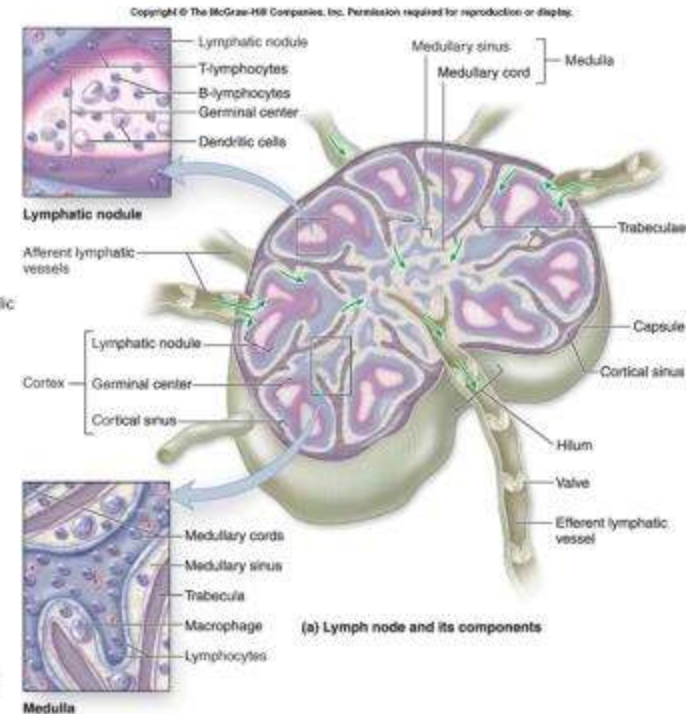
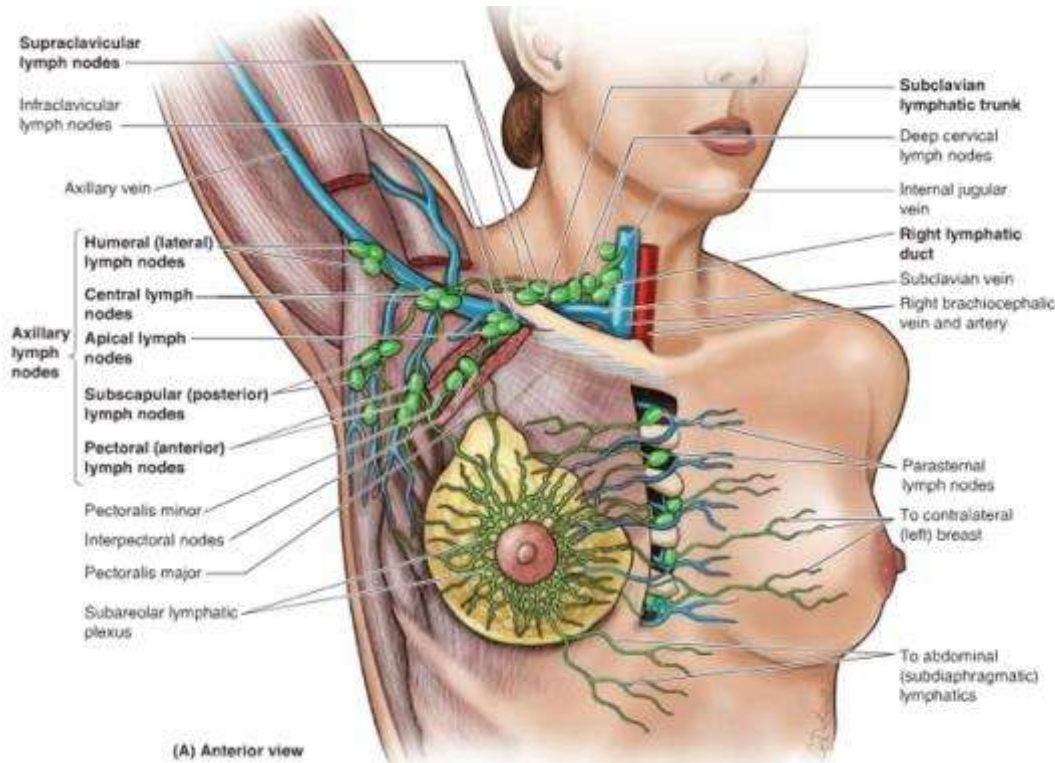
Hematopoiesis

Lymphoid tissue: Thymus



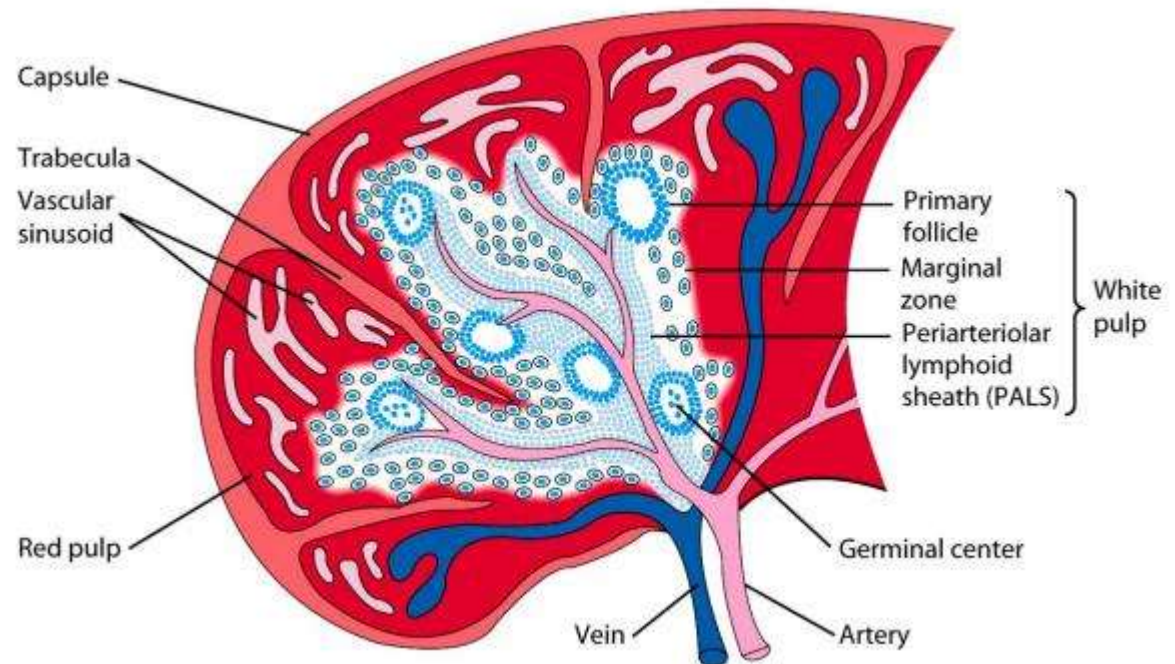
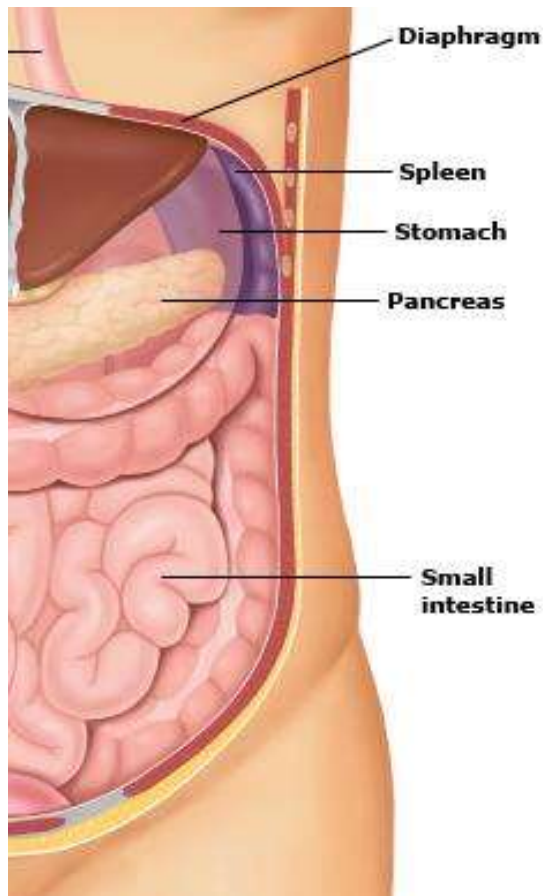
Hematopoiesis

Lymphoid tissue: Lymph nodes



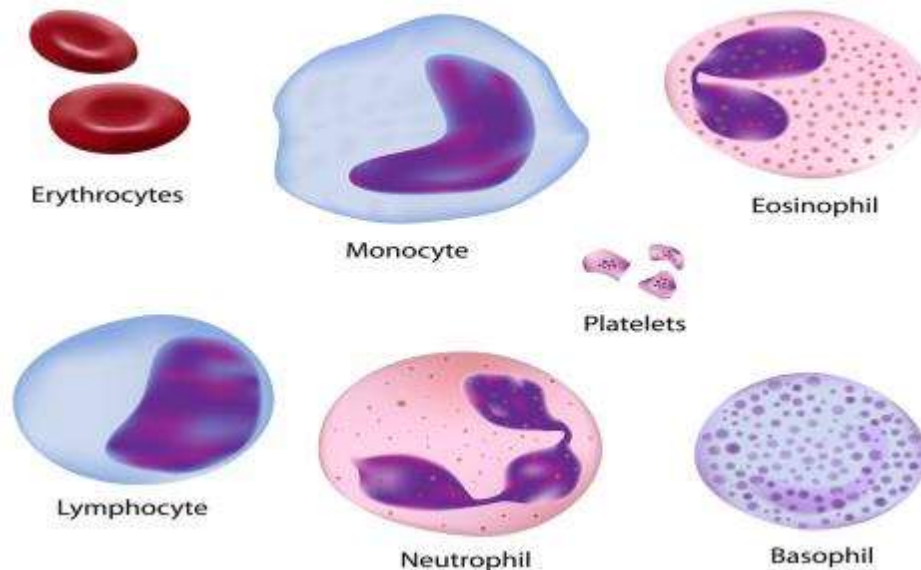
Hematopoiesis

Lymphoid tissue: Spleen



Lifespan of Blood Cells

RBC	120 days
Platelet	10 days
Granulocytes	circ. : 9 hours; tissue : days
Lymphocyte	circ. : hours to years; tissue: weeks to years



Red Blood Cells Functions

- Red blood cells (erythrocytes) are the most abundant cells in the bloodstream and contain hemoglobin, the compound that carries oxygen through the body
- Apart from carrying oxygen they also release the enzyme carbonic anhydrase which allows water in the blood to carry carbon dioxide to the lungs where it is expelled, and control the pH of the blood by acting as an acid-base buffer


Platelets Functions

- Platelets (thrombocytes) contribute to the hemostatic process in two different ways
 - First, through their adhesive and cohesive functions that lead to the formation of a hemostatic plug
 - Second, they can activate coagulation mechanisms through the exposure of an adequate phospholipidic surface, acting as a catalytic site for the development of coagulation and the consolidation of the hemostatic plug


White Blood Cells Functions

- Neutrophils defend against bacterial & fungal infection as the first responders to it
- Eosinophils primarily deal with parasitic infections and allergic reactions
- Basophils promote blood flow and prevent coagulation, they release heparin and histamine
- Monocytes phagocytize pathogens and they present antigens to T cells
- Lymphocytes refer to a group of cells consisting of B cells, T cell and natural killer (NK) cells and are the major components of the body's adaptive immunity

Hematopoietic Response

Hypoxia  RBCs

Infection  Granulocyte/Monocyte

Antigen  Lymphocyte

Hemorrhage  Platelet

Spectrum of Blood Disorders

- Blood Disorders Affecting Red Blood Cells
- Blood Disorders Affecting White Blood Cells
- Blood Disorders Affecting Platelets
- Blood Disorders Affecting Blood Plasma

Blood Disorders Affecting Red Blood Cells

- Anemia
 - Iron-deficiency anemia
 - Anemia of chronic disease
 - Pernicious anemia (B12 deficiency)
 - Aplastic anemia
 - Autoimmune hemolytic anemia
 - Thalassemia
 - Sickle cell anemia
- Polycythemia
- Malaria

Blood Disorders Affecting White Blood Cells

- Lymphoma
- Leukemia (main types)
 - Acute myeloid leukemia (AML)
 - Chronic myeloid leukemia (CML)
 - Acute lymphocytic leukemia (ALL)
 - Chronic lymphocytic leukemia (CLL)
- Multiple myeloma
- Myelodysplastic syndrome

Blood Disorders Affecting Platelets

- Thrombocytopenia
 - Idiopathic thrombocytopenic purpura
 - Heparin -induced thrombocytopenia
- Essential thrombocytosis (primary thrombocythemia)

Blood Disorders Affecting Blood Plasma

- Sepsis
- Hemophilia
- von Willebrand disease
- Hypercoaguable state (hypercoagulable state)
- Deep venous thrombosis
- Disseminated intravascular coagulation (DIC)

Methods of Examination

Complete Blood Count (CBC)

- red blood cells
- white blood cells
 - Differential white blood cells count
- platelets



Methods of Examination

Red Blood Cells

Red blood cells (RBCs) count	4.2 to 5.9 million cells per microliter
Hematocrit (Hct)	Men: 42 to 50%; Women: 36 to 45%
Hemoglobin (Hb)	Men: 12.7 to 13.7 grams per deciliter Women: 11.5 to 12.2 grams per deciliter
Red cell distribution width (RDW)	Less than 14.5%

Other

- Mean volume of red blood cells (MCV – mean corpuscular/cell volume) 80 – 100 femtoliters ($1 \text{ fL} = 10^{-15} \text{ L}$)
- Mean cellular hemoglobin (MCH)
- Mean cellular hemoglobin concentration (MCHC)

Methods of Examination

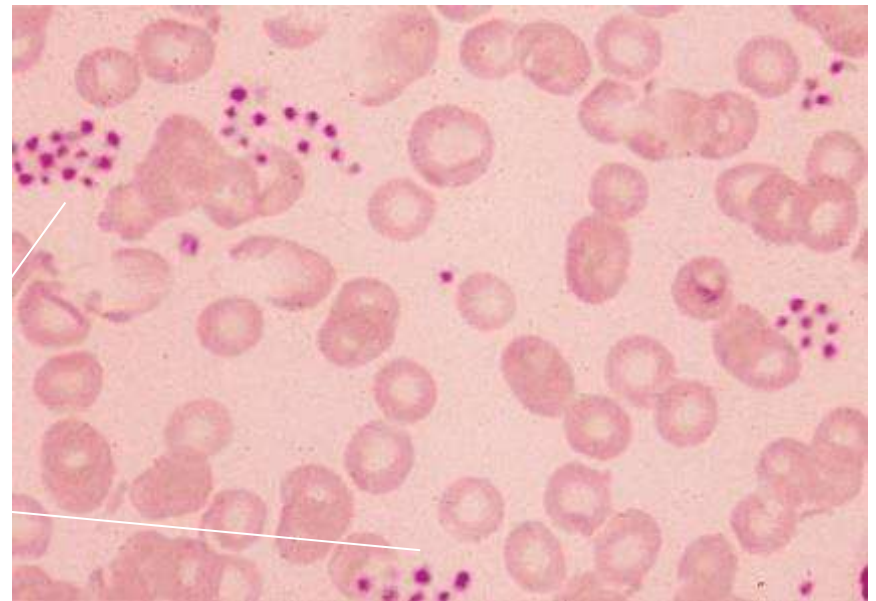
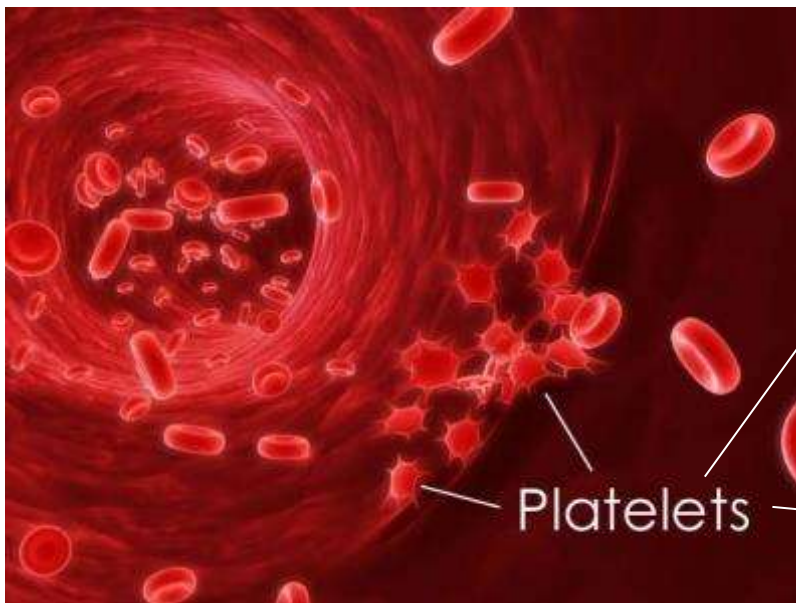
White blood cells count

White blood cells count	4,500 to 10,500 per microliter
Differential white blood cells count	<p>Segmented neutrophils: 34 to 75% (1800 to 7800 1/mL)</p> <p>Band neutrophils (immature segmented neutrophils): 0 to 8% (0 to 1/mL)</p> <p>Lymphocytes: 12 to 50% (1000 to 4800 1/mL)</p> <p>Monocytes: 2 to 9% (0 to 800 1/mL)</p> <p>Eosinophils: 0 to 5% (0 to 450 1/mL)</p> <p>Basophils: 0 to 3% (0 to 200 1/mL)</p>

Methods of Examination

Platelet count

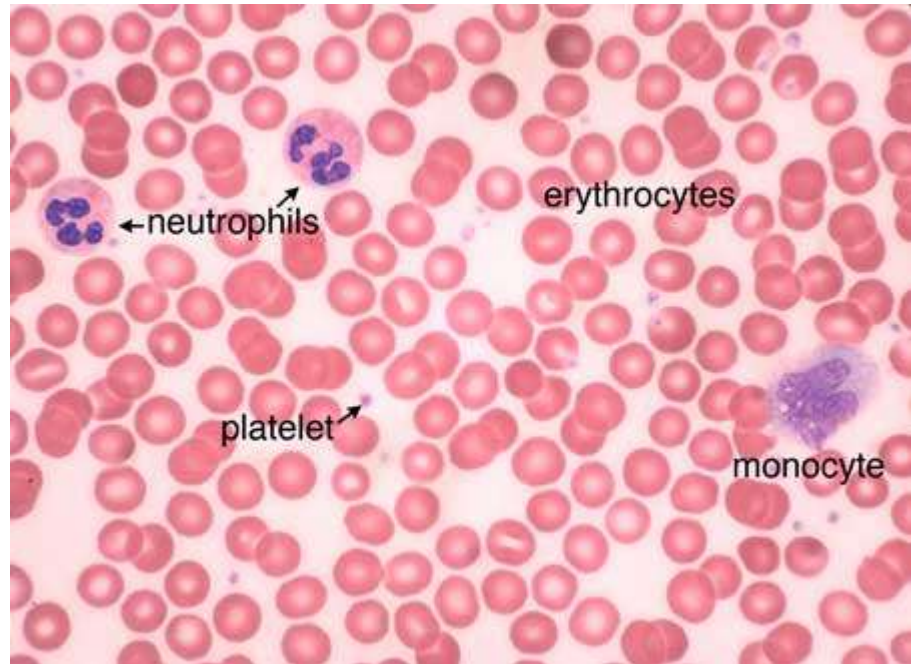
140,000 to 450,000 p



Methods of Examination

Blood Smear:

A follow-up test to abnormal results on a complete blood count (CBC) to evaluate the different types of blood cells



Methods of Examination

Shape and Size of a Red Blood Cell

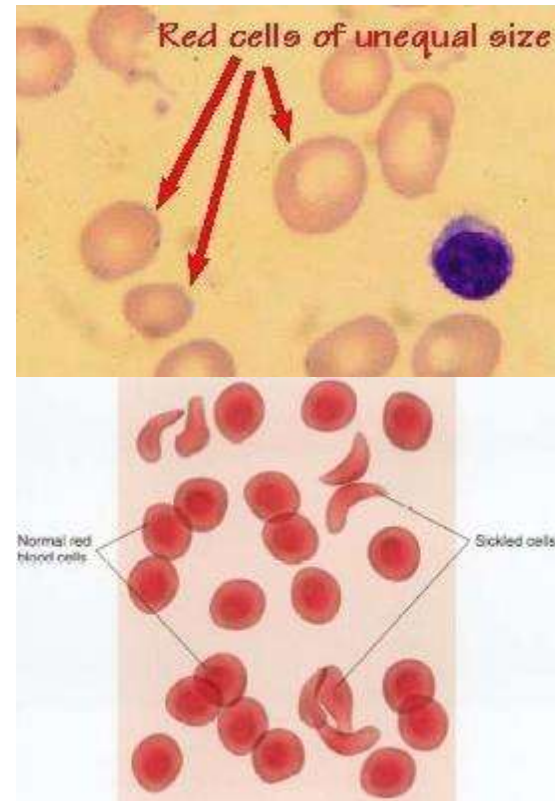
- A red blood cell is a biconcave disc. Simply it is a round ball that is squeezed from two opposite ends to appear, widest at the sides and narrowest in the middle
- A red blood cell measures about 6 to 8 micrometers in diameter (average = 7.8 μm) with an average thickness of 2 micrometers (2.5 μm at the thickest point and less than 1 μm at the center). Although a red blood cell is wider than some capillaries, its flexibility allows it to become distorted as it squeezes through narrow passages and then restores to its original shape

Methods of Examination

Variation and Irregularity of Red Blood Cells:

anisocytosis (aniso = unequal) - various sizes

poikilocytosis (poikilo = various) - various shapes

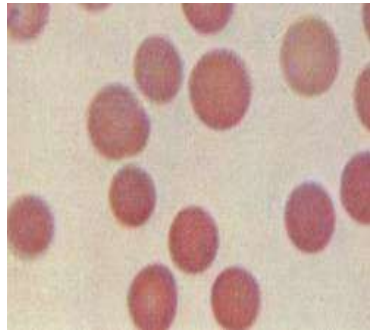


Methods of Examination

Variation and Irregularity of Red Blood Cells



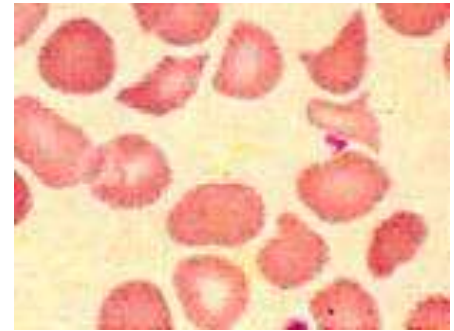
Elliptocytes



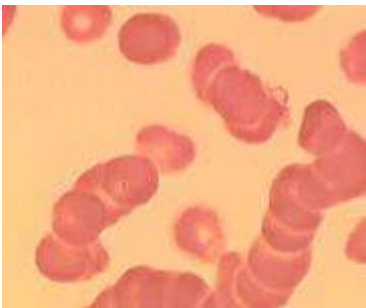
Spherocytes



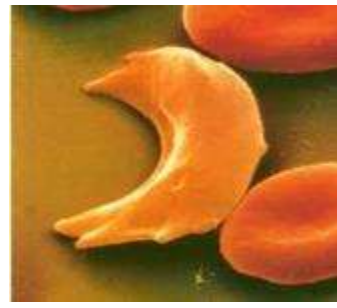
Leptocytes



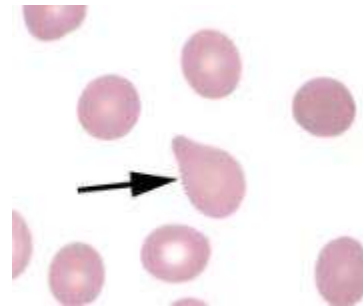
Schistocytes



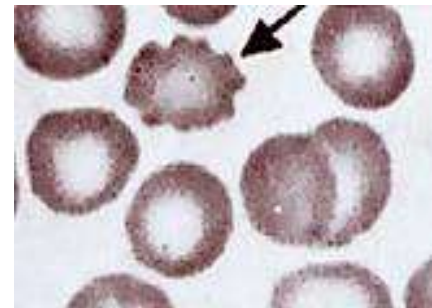
Rouleaux



Sickle cells



Dacrocytes



Echinocytes

Methods of Examination

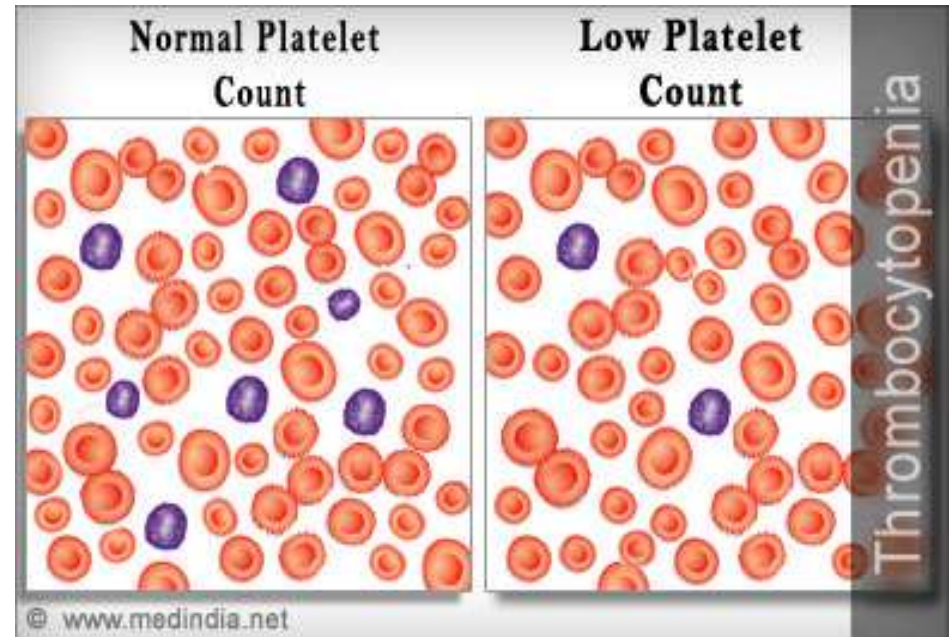
Diagnosis

- The platelet count
- The platelet function (bleeding time, platelet aggregation studies, von Willebrand Factor studies, specialized tests)
- A coagulation screen (clotting factor deficiencies)
- If the patient is on warfarin, INR (International Normalized Ratio)
- Autoantibody screen for connective tissue disorders

Methods of Examination

Platelets

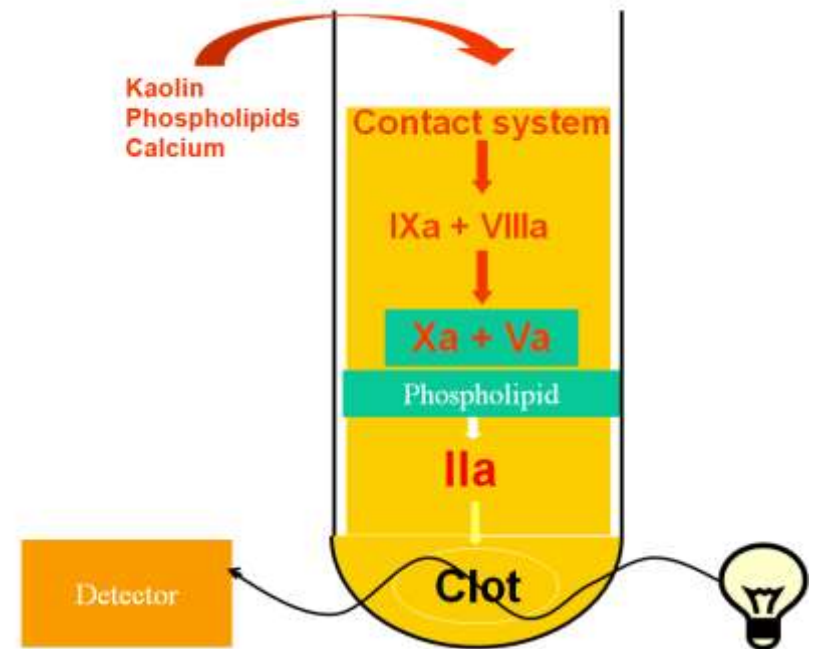
- The platelet count
- The platelet function:
 - bleeding time
 - platelet aggregation studies
 - von Willebrand Factor studies
 - specialized tests



Methods of Examination

Coagulation screen

- Prothrombin ratio
- Activated Partial Thromboplastin time
- Thrombin clotting time
- Fibrinogen



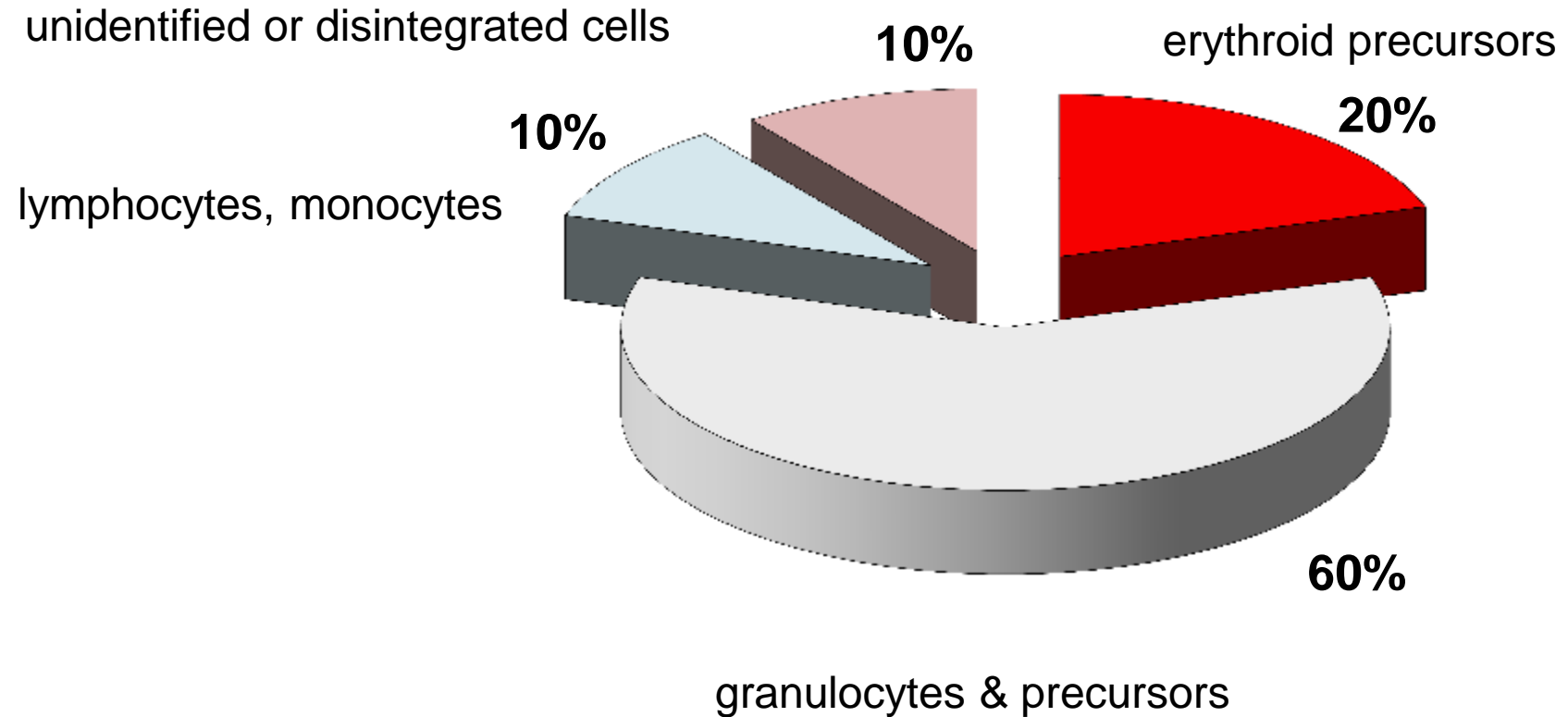
Methods of Examination

Bone Marrow Examination (usually from the iliac crest or from the sternum)

- Bone marrow aspirate
 - what cells, normal and abnormal, are present in the bone marrow
- Bone marrow core biopsy
 - how full the bone marrow is with cells and where the cells are located within the marrow

Methods of Examination

Normal Marrow Composition



Methods of Examination

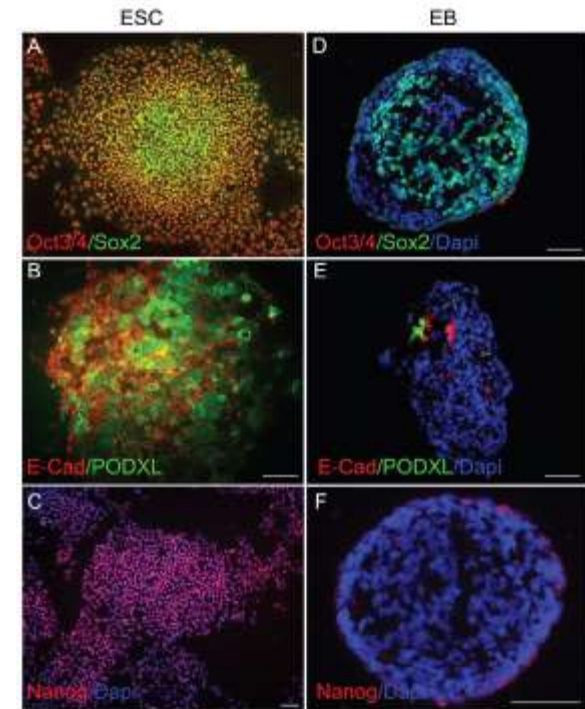
Markers

Stem cell: CD34, c-kit
rhodamine, Hoechst
dyes (pale)

B-cell: CD19, CD20, (CD22),
CD79a

T-cell: CD3, CD2, CD5,
CD4/CD8

NK-cell: CD16, CD57, CD56



Anemia

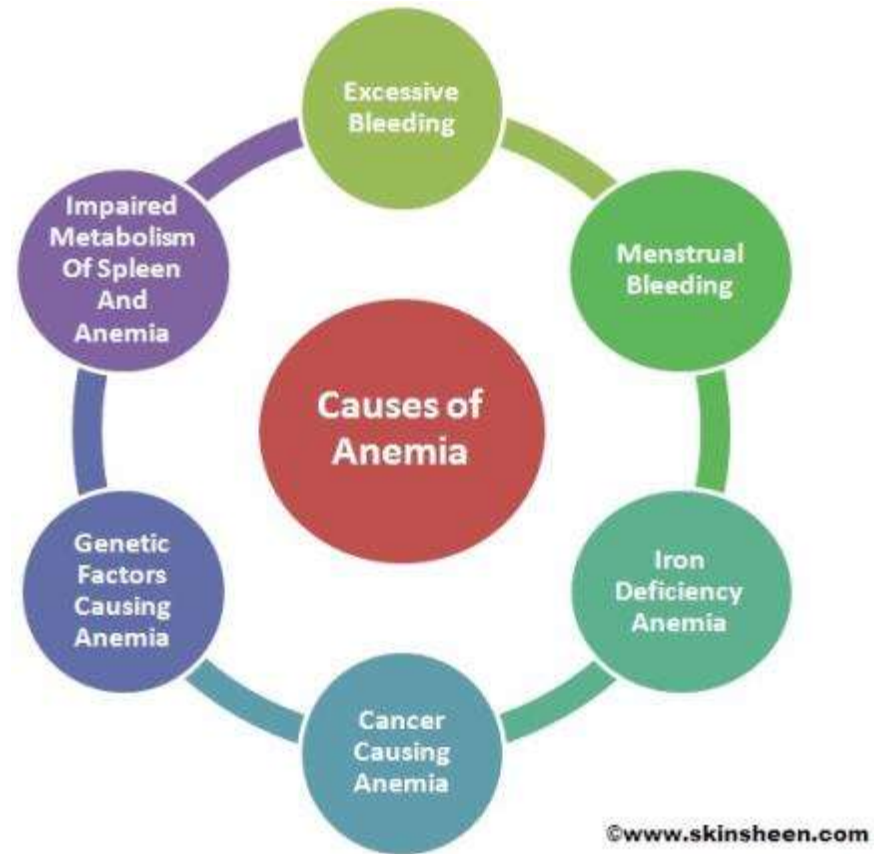
Definition

Anemia (anaemia) is a decrease in the amount of RBCs or hemoglobin in the blood or a lowered ability of the blood to carry oxygen

Anemia

Causes

- Impaired RBC production
- Increased RBC destruction
- Blood loss
- Fluid overload



Anemia

Causes: Impaired production

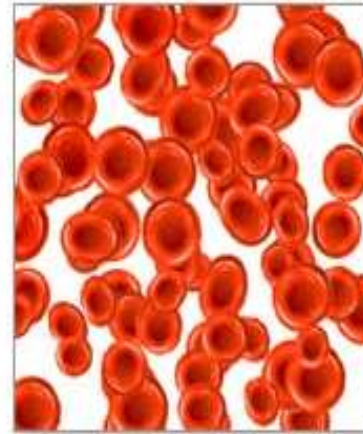
- Disturbance of proliferation and differentiation of stem cells (Pure red cell aplasia, Aplastic anemia, Anemia of renal failure, Anemia of endocrine disorders)
- Disturbance of proliferation and maturation of erythroblasts (Pernicious anemia, Anemia of folic acid deficiency, Megaloblastic anemia, Anemia of prematurity, Iron deficiency anemia, Thalassemias, Congenital dyserythropoietic anemias, etc.)
- Other mechanisms of impaired RBCs production (Myelophthisic anemia, Myelodysplastic syndrome, Anemia of chronic inflammation)

Anemia

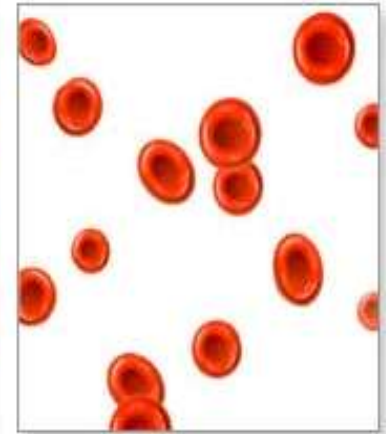
Causes: Increased RBCs destruction (hemolytic anemias)

- Intrinsic (intracorpuseular) abnormalities cause premature destruction (except paroxysmal nocturnal hemoglobinuria, are hereditary genetic disorders)
- Extrinsic (extracorpuseular) abnormalities (antibody-mediated, mechanical trauma to red cells)

Normal amount of red blood cells



Anemic amount of red blood cells



Anemia

Causes: Blood loss

- Anemia of prematurity
- Trauma or surgery, causing acute blood loss
- Gastrointestinal tract lesions (acute bleeds: peptic ulcers, chronic blood loss (angiodysplasia))
- Gynecologic disturbances (chronic blood loss)
- Menstruation, among young women or older women with fibroids
- Infection by intestinal nematodes feeding on blood

Anemia

Hydremia

Causes: Fluid overload (hypervolemia with hemodilution, normal total amount of Hb and RBCs in the body)

- Excessive sodium or fluid intake, sodium or water retention and fluid shift into the intravascular space
- Anemia of pregnancy (induced by blood volume expansion experienced in pregnancy)



Anemia

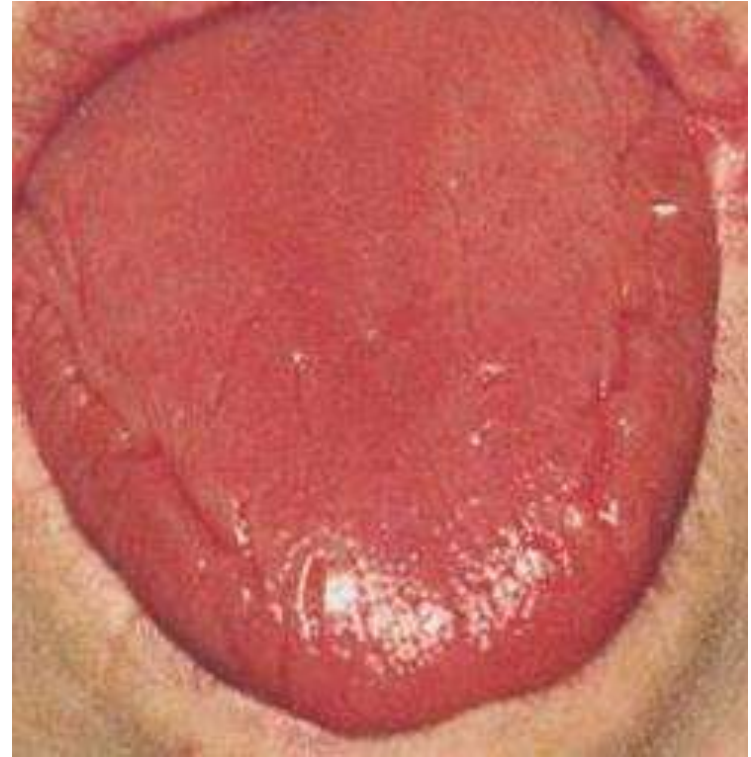
Diagnostic steps

- Clinical manifestations
- Hematological syndromes (blood tests abnormalities)
- Blood biochemistry abnormalities
- Bone marrow abnormalities

Anemia

Signs and symptoms

- weakness, fatigue, general malaise, poor concentration
- dyspnea (shortness of breath) on exertion
- increasing cardiac output, palpitations, angina (if pre-existing heart disease is present), heart failure
- intermittent claudication
- pallor (pale skin, lining mucosa, conjunctiva and nail beds)



Anemia

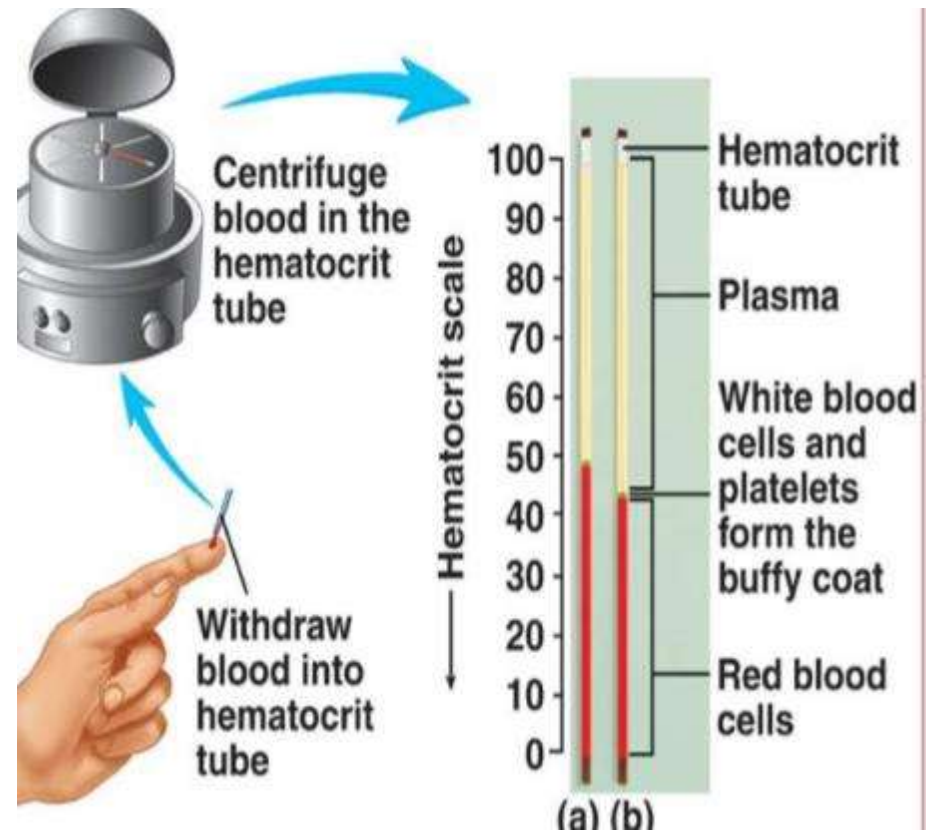
Additional signs of severe anemia

- hyper dynamic circulation
(tachycardia, bounding pulse, flow murmurs, cardiac ventricular hypertrophy)
- heart failure
- pica
- restless legs syndrome (iron-deficiency anemia)

Anemia

Diagnosis

- Complete blood count
- Blood smear
- Hemoglobin
- Hematocrit
- Red blood cell size
- Reticulocyte count
- Reticulocyte production index



Anemia

WHO's Hemoglobin Thresholds used to define Anemia

Age, Gender	Hb threshold (g/dl)	Hb threshold (mmol/l)
Children (0.5–5.0 yrs)	11.0	6.8
Children (5–12 yrs)	11.5	7.1
Teens (12–15 yrs)	12.0	7.4
Women, non-pregnant (>15yrs)	12.0	7.4
Women, pregnant	11.0	6.8
Men (>15yrs)	13.0	8.1

Anemia

Color index

- Hypochromic ($<0,85$) – e. g. chronic posthemorrhagic, Fe-deficient
- Normochromic ($0,85 - 1,05$) – e. g. acute posthemorrhagic, hemolytic
- Hyperchromic ($>1,05$) – e.g. B12-deficient, folate-deficient, aplastic

Anemia

Types of red blood cells size

- The cells are small - microcytic anemia (MCV < 80 fL) - e.g. Fe deficient anemia
- The cells are large - macrocytic anemia (MCV > 100 fL) – e.g. B12-folate deficient anemia
- The cells are normal - normocytic anemia - e.g. anemia if chronic diseases



Anemia

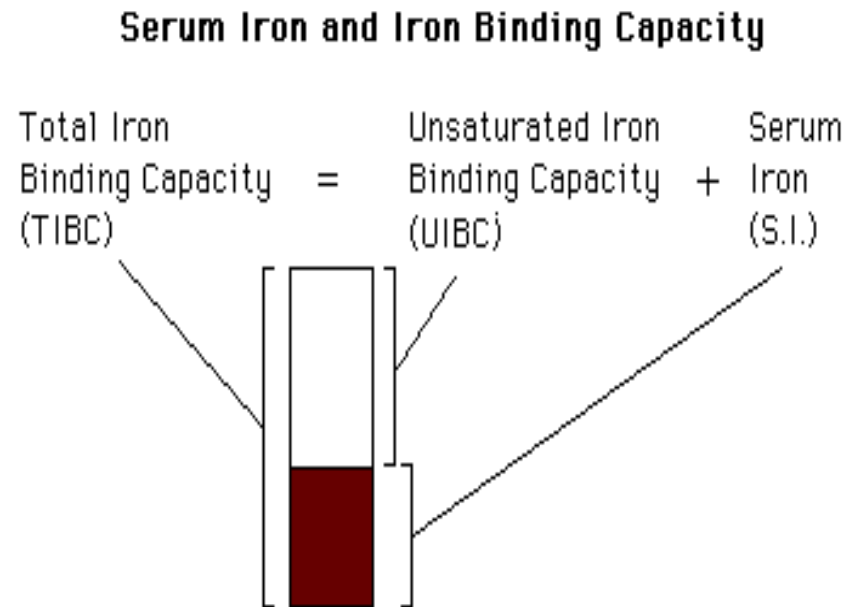
Regenerative abilities of bone marrow-
reticulocytes, %

- Normoregenerative (6 – 12) – anemias due to deficiency (Fe, B12-folate, etc.)
- Hyperregenerative (> 12) – hemolytic,
acute posthemorrhagic
- Hyporegenerative (< 6) – aplastic

Anemia

Blood biochemistry

- Ferritin (↓ in Fe deficiency)
- Serum iron (↓ in Fe deficiency)
- Transferrin saturation (↓ in Fe deficiency)
- RBC folate level
- Serum vitamin B₁₂
- Serum methylmalonic acid and homocysteine (in B₁₂ def.)
- Renal and liver function tests
- Erythropoietin level



Polycythemia

Definition

Polycythemia is a myeloproliferative condition that results in an increased level of circulating red blood cells in the bloodstream with increase in hematocrit, hemoglobin, or red blood cell count above the normal limits

Polycythemia

Synonyms

Erythremia

Osler-Vaquez disease

Polycythemia rubra vera

Primary polycythemia

Splenomegalic polycythemia

Vaquez-Osler disease

Polyglobulia

Polycythemia

Risk factors:

- Hypoxia from long standing (chronic) lung disease and smoking
- Chronic carbon monoxide (CO) exposure
- People living at high altitudes due to low environmental oxygen levels
- People with genetic mutations and familial types of polycythemia and certain hemoglobin abnormalities

Polycythemia

Causes

- Primary (a slow-growing type of blood cancer)
 - Polycythemia Vera
 - Primary familial and congenital polycythemia
- Secondary
 - Physiologically appropriate (adaptation to living at high altitudes, iatrogenic, etc.)
 - Chronic hypoxia (COPD, hypoventilation syndrome, chronic heart diseases, sleep_apnea, pulmonary_hypertension)
 - Erythropoietin secreting tumors (hepatocellular carcinoma, renal cell carcinoma, adenocarcinomas, uterine tumors)
 - Relative polycythemia (the underlying cause is reduced blood plasma)

Polycythemia

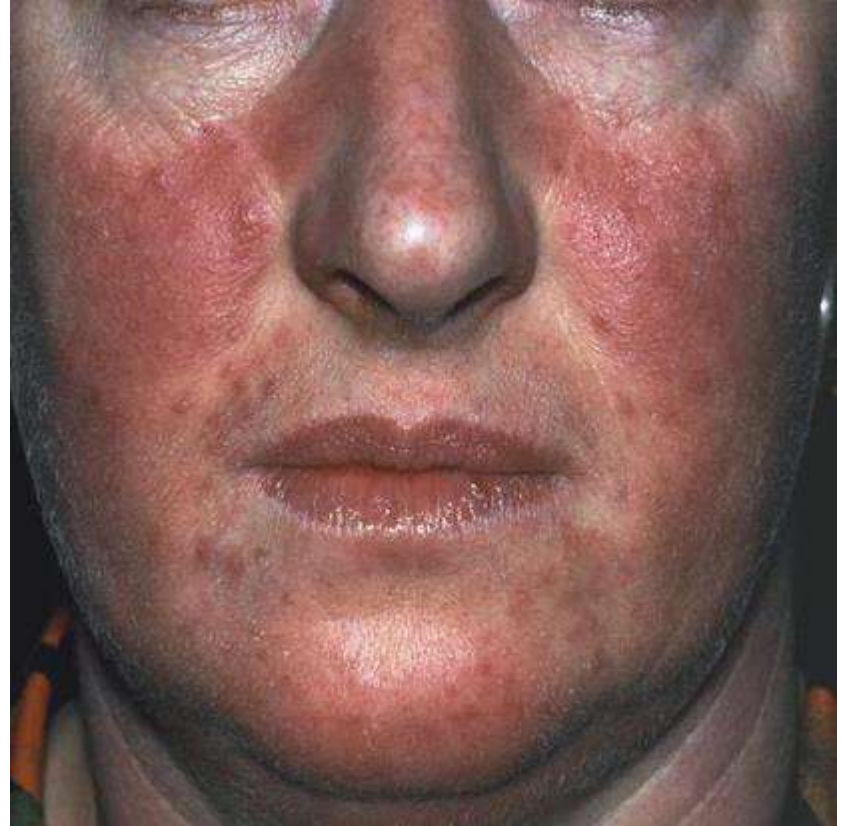
Signs and symptoms Polycythemia Vera

- Trouble breathing when lying down
- Dizziness
- Excess bleeding
- Full feeling in the left upper abdomen (enlarged spleen)
- Headache
- Itchiness, especially after a warm bath
- Red skin coloring, especially of the face
- Shortness of breath
- Phlebitis

Polycythemia

Other symptoms that may occur with Polycythemia Vera

- Bluish skin color
- Fatigue
- Red skin spots
- Vision problems



Polycythemia

Diagnosis

- Bone marrow biopsy
- Complete blood count with differential
- Comprehensive metabolic panel
- Erythropoietin level
- Genetic test for the JAK2V617F mutation
- Oxygen saturation of the blood
- Red blood cell mass
- Vitamin B12 level



Polycythemia

Diagnosis (WHO criteria):

- Major criteria
 - Hemoglobin > 18.5 g/dL in men and > 16.5 g/dL in women, or other evidence of increased red blood cell volume
 - Presence of JAK2617V F or other functionally similar mutation, such as *JAK2* exon 12 mutation
- Minor criteria
 - Bone marrow biopsy showing hypercellularity for age with trilineage growth (panmyelosis) with prominent erythroid, granulocytic, and megakaryocytic proliferation
 - Serum erythropoietin level below the reference range for normal
 - Endogenous erythroid colony formation in vitro

Polycythemia

Diagnosis (The Polycythemia Vera Study Group criteria : the diagnosis is established if all three category A criteria are present, or if criteria A1 plus A2 plus any two criteria from category B are present):

- Category A criteria
 - Total red blood cell mass ≥ 36 mL/kg in males or ≥ 32 mL/kg in females
 - Arterial oxygen saturation $\geq 92\%$
 - Splenomegaly
- Category B criteria
 - Thrombocytosis, with platelet count $> 400,000/\mu\text{L}$
 - Leukocytosis, with a white blood cell count $> 12,000/\mu\text{L}$
 - Increased leukocyte alkaline phosphatase (ALP) > 100 U/L
 - Serum vitamin B-12 concentration > 900 pg/mL or binding capacity > 2200 pg/mL

Leukopenia

Definition

Leukopenia or leucopenia or leukocytopenia is a decrement in the white blood cells (WBC) or leukocytes present in the blood that places individuals at greater infection risks

Leukopenia

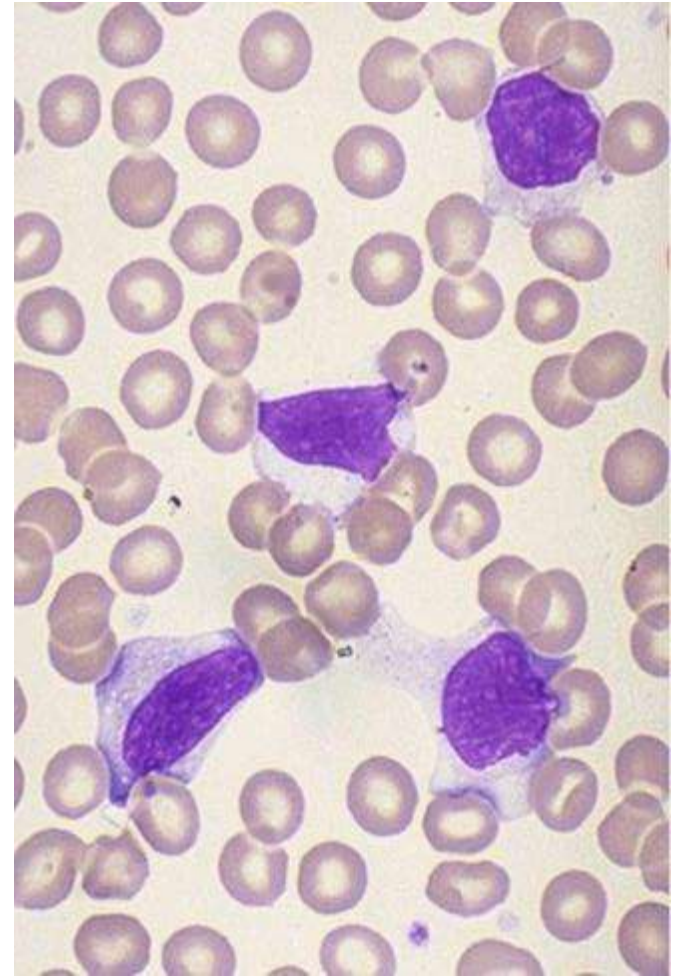
Causes

- Viral infections (cold/flu, HIV/AIDS, etc.)
- Microbial infections (sepsis, psittacosis, rickettsial infections, tuberculosis, malaria, dengue, etc.)
- Autoimmune connective tissue diseases (rheumatoid arthritis, systemic lupus erythematosus, etc.)
- Cancer or other diseases that damage bone marrow (leukemia, myelofibrosis, Hodgkin's lymphoma)
Congenital disorders (Kostmann's syndrome, Myelokathexis)
- Vitamin deficiencies (folate deficiency, etc.)
- Deficiency of minerals (zinc, copper, etc.)
- Medications and radiation therapy (diuretics , antibiotics, antipsychotics, antidepressants, etc.)

Leukopenia

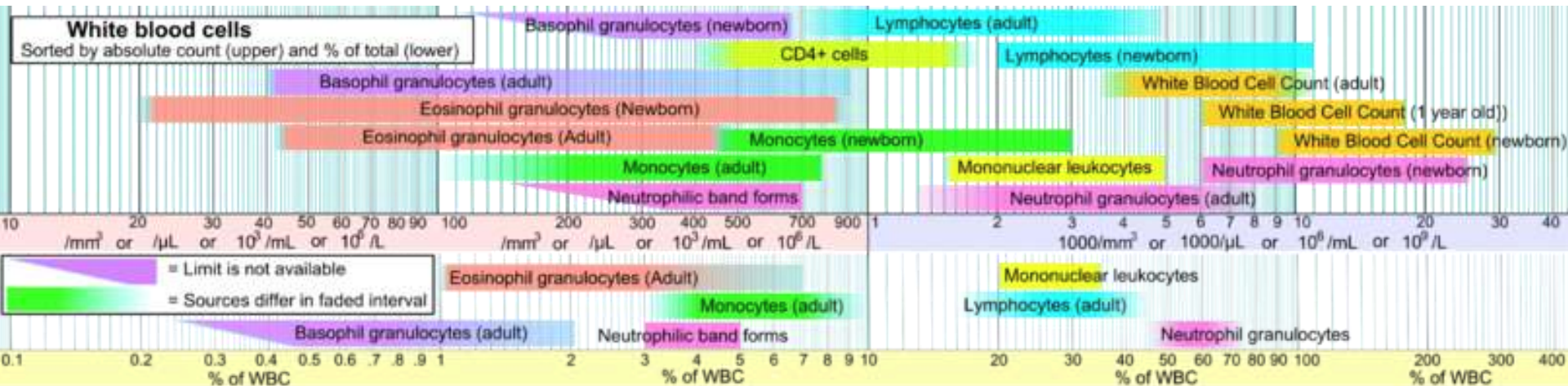
Signs and symptoms

- Anemia
- Thrombocytopenia
- Pneumonia
- Stomatitis, oral ulcer and various infections
- Liver abscesses
- Metrorrhagia, menorrhagia
- Neurasthenia
- Fatigue and hot flashes
- Strong desire to consume hot drinks



Leukopenia

Diagnosis: leukopenia can be identified with a complete blood count



Leukocytosis

Definition

A white blood cell (the leukocyte) count above the normal range ($<50 \times 10^9/\text{L}$) in the blood

Leukocytosis

Five principal types and Causes

Neutrophilic leukocytosis (neutrophilia)	Bacterial infections, Tissue necrosis
Eosinophilic leukocytosis (eosinophilia)	Allergic disorders, Parasitic infections, Malignancy, Systemic autoimmune diseases, etc.), Acute stress
Basophilic leukocytosis (basophilia)	Myeloproliferative disease
Monocytosis	Chronic infections (Tuberculosis, Systemic autoimmune diseases, etc.)
Lymphocytosis	Chronic infections (Tuberculosis, Brucellosis, Viral infections, Pertussis, Malignancy

Leukocytosis

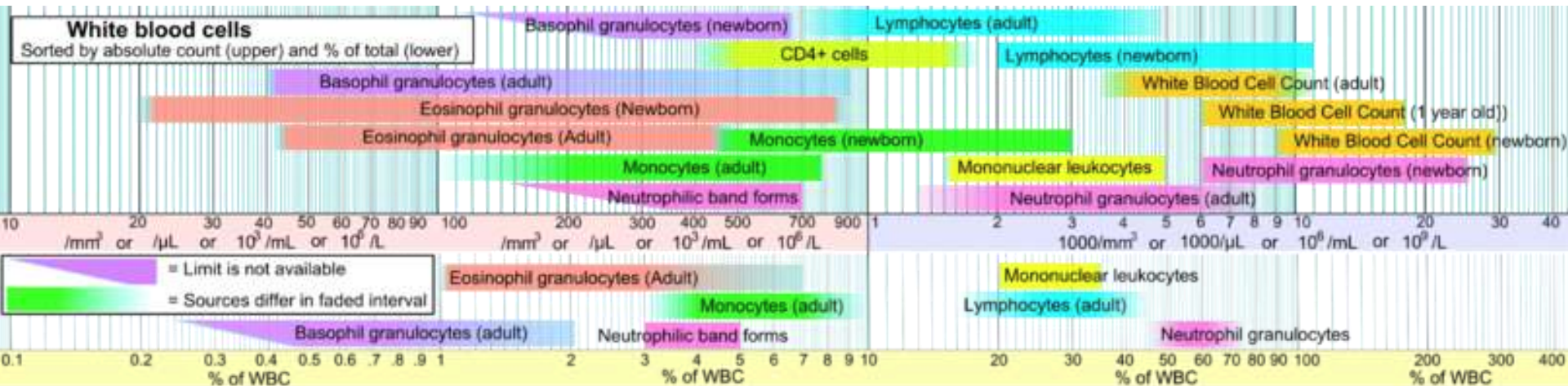
Signs and symptoms

- Fever
- Bleeding or bruising
- Feeling weak, tired, or sick
- Feeling dizzy, faint, or sweaty
- Pain or tingling in arms, legs, or abdomen
- Trouble breathing, thinking, or seeing
- Losing weight without trying, or a poor appetite



Leukocytosis

Diagnosis: leukocytosis can be identified with a complete blood count



Leukocytosis

Comment

- Excessive numbers of white blood cells are most often due to the response of normal bone marrow to infection or inflammation
- In some instances, leukocytosis is a sign of more serious primary bone marrow disease (leukemia or myeloproliferative disorders)

Hemorrhagic Syndrome

Definition

The extravasation of red blood cells from the vasculature into the skin and/or subcutaneous tissue in form of petechiae, purpura, and ecchymoses (collectively referred to as purpura) with purpuric rashes formation

Hemorrhagic Syndrome

Appendix for Definition

The extravasation occur internally, where red blood cells leaks from blood vessels inside the body

Hemorrhagic Syndrome

Purpura forms

- Petechiae - pinpoint red lesions less than 2 mm in size
- Purpura - pinpoint red lesions from 2 mm to 10 mm in size
- Ecchymoses pinpoint red lesions more than 10 mm in size



Hemorrhagic Syndrome

Principal types and Causes

Thrombocytopathy	Any of blood disorders characterized by dysfunctional platelets (thrombocytes) with either normal platelet counts (non-thrombocytopenic purpuras) or decreased platelet counts (thrombocytopenic purpuras), which result in prolonged bleeding time, defective clot formation, and a tendency to hemorrhage (Henoch-Schönlein Purpura, von Willebrand disease, thrombasthenia, platelet aggregation, etc.)
Hemophilia	A group of hereditary genetic disorders that impair the body's ability to control blood clotting, which is used to stop bleeding when a blood vessel is broken (Hemophilia A - clotting factor VIII deficiency (the most common form of the disorder) and Hemophilia B - factor IX deficiency (occurs in around 1 in about 20,000–34,000 male births)
Telangiectasia	A small dilated blood vessels near the surface of the skin or mucous membranes, measuring between 0.5 and 1 millimeter in diameter

Hemorrhagic Syndrome

Signs and symptoms

- Purpura, sometimes mucosal bleeding (localization, distribution)
- Arthritis and Arthralgia
- Central Nervous, Gastrointestinal, Cardiovascular, Urethral Systems involvement
- Prolonged, heavy menstrual periods (menorrhagia)
- Unexplained nosebleeds
- Extended bleeding after minor cuts, blood draws or vaccinations, minor surgery or dental procedures
- Bleeding after aspirin

Hemorrhagic Syndrome

WHO' grading scale to measure the severity of bleeding

Grade 0	no bleeding
Grade 1	petechial bleeding
Grade 2	mild blood loss (clinically significant)
Grade 3	gross blood loss, requires transfusion (severe)
Grade 4	debilitating blood loss, retinal or cerebral associated with fatality

Hemorrhagic Syndrome

Diagnosis

- The platelet count
- The platelet function (bleeding time, platelet aggregation studies, von Willebrand Factor studies, specialized tests)
- A coagulation screen (clotting factor deficiencies)
- If the patient is on warfarin, INR (International Normalized Ratio)
- Autoantibody screen for connective tissue disorders

Leukemia

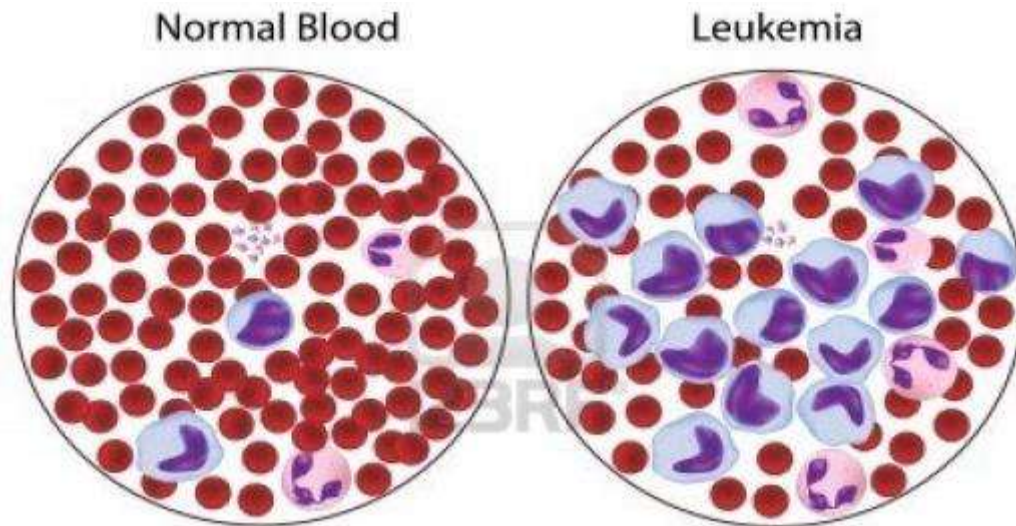
Definition

Abnormal proliferation of the blood-forming tissues that usually begins in the bone marrow and results in high numbers of abnormal white blood cells

Leukemia

Causes

- Mutations in the DNA as a result of exposure to radiation or carcinogenic substance
- A genetic predisposition



Leukemia

Classification

Cell type	Acute	Chronic
Lymphocytic (lymphoblastic) leukemia	Acute lymphoblastic leukemia (ALL)	Chronic lymphocytic leukemia (CLL)
Myelogenous (myeloid) leukemia	Acute myeloblastic leukemia (AML)	Chronic myelogenous leukemia (CML)

Leukemia

Signs and symptoms

- Fever or chills
- Persistent fatigue, weakness
- Frequent or severe infections
- Losing weight without trying
- Swollen lymph nodes, enlarged liver or spleen
- Easy bleeding or bruising
- Recurrent nosebleeds
- Tiny red spots in skin (petechiae)
- Excessive sweating, especially at night
- Bone pain or tenderness

Leukemia

Acute leukemia

is characterized by a rapid increase in the number of immature blood cells (blasts) crowding due to such cells makes the bone marrow unable to produce healthy blood cells immediate treatment is required in acute leukemia due to the rapid progression and accumulation of the malignant cells, which then spill over into the bloodstream and spread to other organs of the body

Leukemia

Chronic leukemia

is characterized by the excessive buildup of relatively mature, but still abnormal, white blood cells

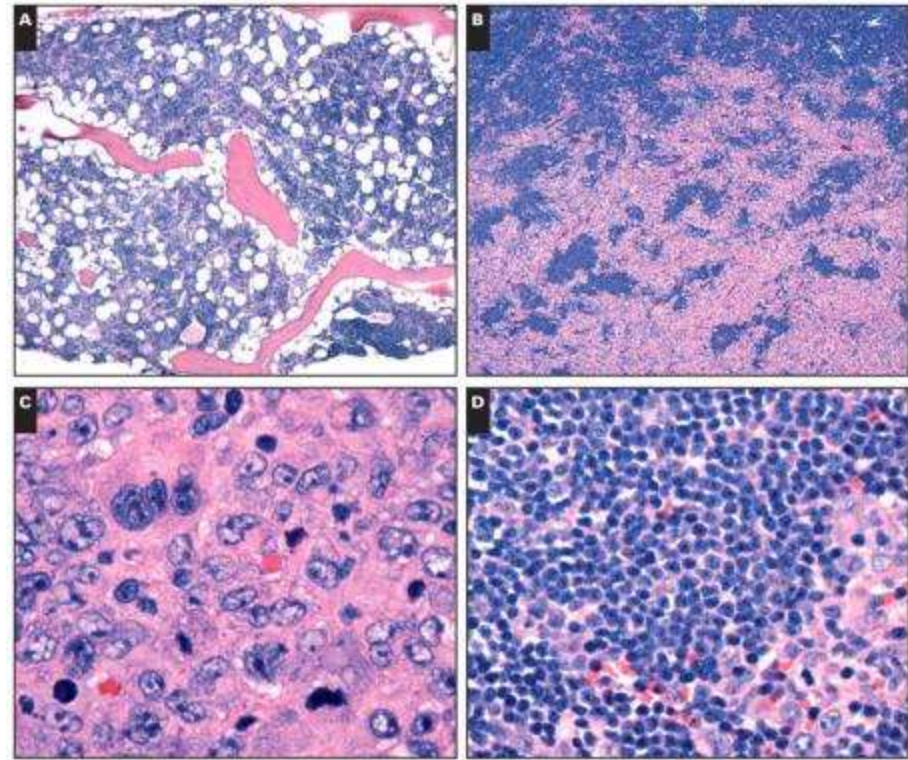
typically taking months or years to progress, the cells are produced at a much higher rate than normal, resulting in many abnormal white blood cells

mostly occurs in older people, but can theoretically occur in any age group

Leukemia

Diagnosis

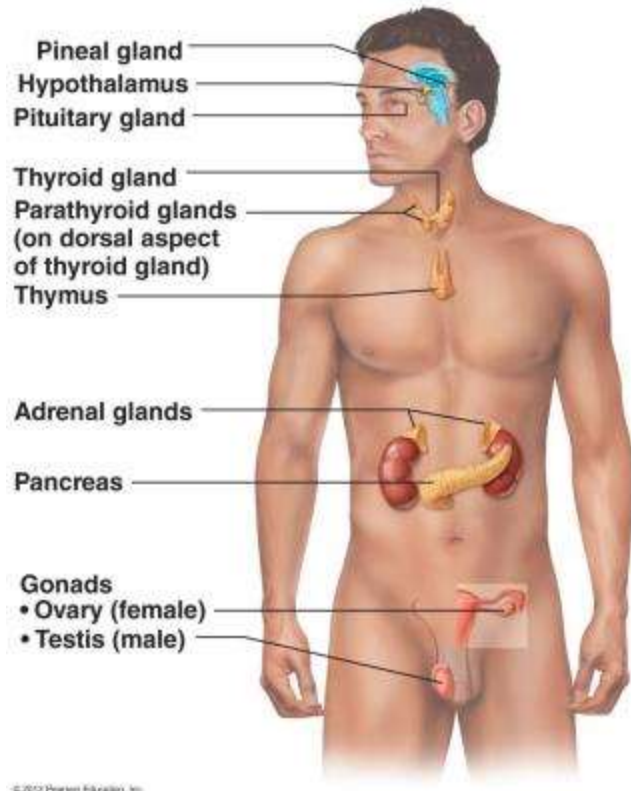
- Repeated complete blood counts and blood films
- Philadelphia chromosome in CML
- Bone marrow examination
- A lymph node biopsy (in lymphoma)
- X-ray, MRI, or ultrasound



Lecture 18

Syndromes of the endocrine system diseases

Plan of the lecture



More Recently Identified:
Kidneys, Heart/blood, Liver,
Brain, Fat (adipose) tissue,
Placenta

- **Definition of endocrine system**
- **Spectrum of endocrine diseases and metabolic disorders**
- **Thyroid gland**
 - Reminder (how do thyroid gland works)
 - History-taking
 - Patient's examination (clinical, laboratory, instrumental)
 - symptoms and syndromes
- **Endocrine pancreas**
 - Reminder (how do pancreas works)
 - History-taking
 - Patient's examination (clinical, laboratory, instrumental)
 - symptoms and syndromes
- **Glossary of terms referred to endocrine diseases and metabolic disorders**

Definition of endocrine system

The endocrine system is a group of glands (organs) that regulate physiological functions by releasing hormones into the bloodstream. Hormones are chemicals that carry information to different parts of the body; specific hormones influence certain organs or parts of the body, such as the liver or pancreas.

The endocrine system regulates development and growth (for example, puberty), metabolism, sexual and reproductive processes. It includes the reproductive glands, adrenal glands, thyroid glands, hypothalamus, pancreas, and pituitary glands. Although distinct from the nervous system, the endocrine system interacts with the nervous system through the hypothalamus, which regulates the pituitary gland function.

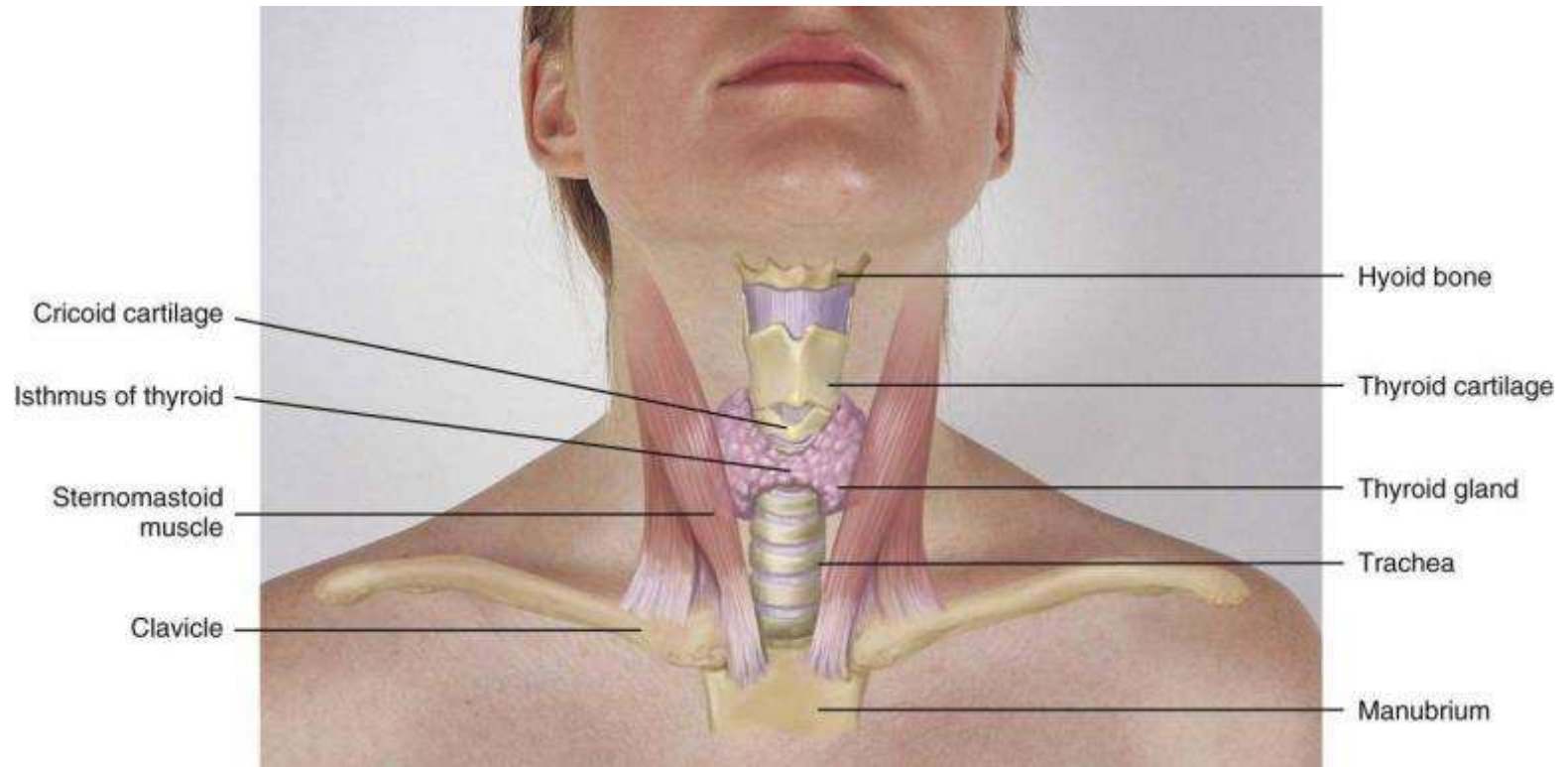
The word endocrine derives from the Greek words "endo," meaning within, and "crinis," meaning to secrete.

Spectrum of endocrine diseases and metabolic disorders

- **Adrenal disorders:** Adrenal insufficiency, Adrenal hormone excess, Congenital adrenal hyperplasia, Adrenocortical carcinoma
- **Glucose homeostasis disorders:** Diabetes mellitus, Hypoglycemia
- **Thyroid disorders:** Goiter, Hyperthyroidism, Hypothyroidism, Thyroidites, Thyroid cancer, Thyroid hormone resistance
- **Calcium homeostasis disorders and Metabolic bone diseases:** Hyperparathyroidism, Hypoparathyroidism, Pseudohypoparathyroidism, Osteoporosis, Osteitis deformans, Rickets, Osteomalacia
- **Pituitary gland disorders:** Posterior pituitary - Diabetes insipidus, Anterior pituitary - Hypopituitarism, Pituitary tumors, Hyperprolactinemia, Acromegaly, gigantism, Cushing's disease, Growth failure, Dwarfism
- **Sex hormone disorders:** Disorders of sex development, Hypogonadism, Disorders of Puberty, Menstrual function disorders,
- **Tumours of the endocrine glands not mentioned elsewhere:** Multiple endocrine neoplasia, Carcinoid syndrome

Thyroid gland

reminder: how does thyroid gland works



https://www.youtube.com/watch?v=u2tRkaEp_j4

Thyroid gland

reminder: the primary functions, T3 & T4 hormones

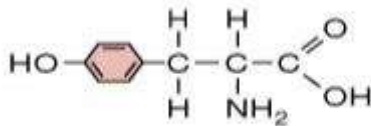
- The primary function of the thyroid is production of the hormones T3, T4 and calcitonin. Up to 80% of the T4 is converted to T3 by organs such as the liver, kidney and spleen. T3 is several times more powerful than T4, which is largely a prohormone, perhaps four or even ten times more active
- The production of T3, T4 is regulated by thyroid-stimulating hormone (TSH), released by the anterior pituitary. The thyroid and thyrotropes form a negative feedback loop: TSH production is suppressed when the T4 levels are high
- T3, T4 act on nearly every cell in the body to increase the basal metabolic rate, affect protein synthesis, help regulate long bone growth and neural maturation, and increase the body's sensitivity to catecholamines by permissiveness. T3, T4 are essential to proper development and differentiation of all cells of the human body. T3, T4 also regulate protein, fat, and carbohydrate metabolism, affecting how human cells use energetic compounds. They also stimulate vitamin metabolism. Numerous physiological and pathological stimuli influence T3, T4 synthesis
- T3, T4 leads to heat generation in humans

Thyroid gland

reminder: T3 & T4 hormones

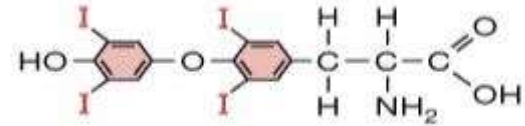
(derived from modification of tyrosine)

Tyrosine



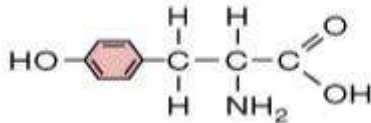
I

Thyroxine (T₄)



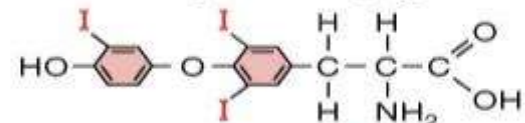
(2 tyrosine + 4 I)

Tyrosine



I

Triiodothyronine (T₃)



(2 tyrosine + 3 I)

- The thyroid secretes about 80 mg of T₄, but only 5 mg of T₃ per day
- T₃ has a much greater biological activity (about 10 X) than T₄
- An additional 25 mg/day of T₃ is produced by peripheral monodeiodination of T₄

Thyroid gland

reminder: functional effects of T3 & T4 hormones

Cardiovascular System

- Increase heart rate
- Increase force of cardiac contractions
- Increase stroke volume
- Increase cardiac output
- Up-regulate catecholamine receptors

Respiratory System

- Increase resting respiratory rate
- Increase minute ventilation
- Increase ventilatory response to hypercapnia and hypoxia

Renal System

- Increase blood flow
- Increase glomerular filtration rate

Intermediary Metabolism

- Increase glucose absorption from the GI tract
- Increase carbohydrate, lipid and protein turnover
- Down-regulate insulin receptors
- Increase substrate availability

Thyroid gland

reminder: functional effects of T3 & T4 hormones

Oxygen-Carrying Capacity

- Increase RBC mass
- Increase oxygen dissociation from hemoglobin

Growth and Tissue Development

- Increase growth and maturation of bone
- Increase tooth development and eruption
- Increase growth and maturation of epidermis, hair follicles and nails
- Increase rate and force of skeletal muscle contraction
- Inhibits synthesis and increases degradation of mucopolysaccharides in subcutaneous tissue

Nervous System

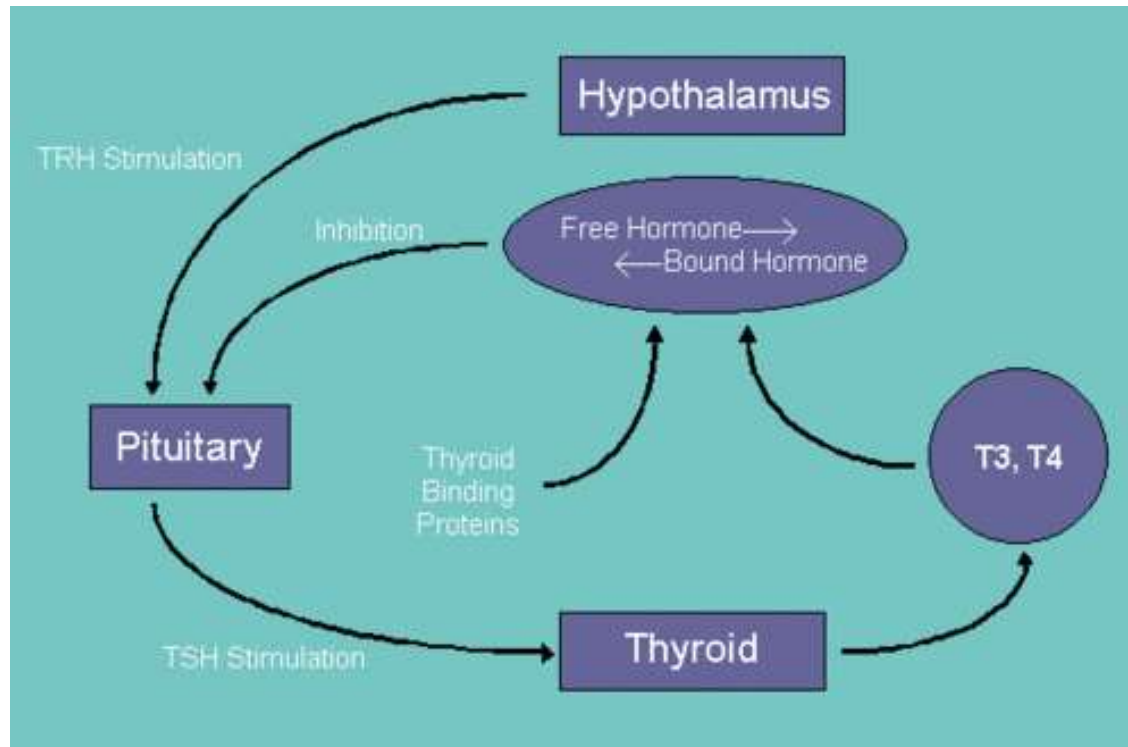
- Critical for normal CNS neuronal development
- Enhances wakefulness, alertness, memory and learning capacity
- Required for normal emotional tone
- Increase speed and amplitude of peripheral nerve reflexes

Reproductive System

- Required for normal follicular development, ovulation, maintenance of pregnancy in the female, spermatogenesis in the male

Thyroid gland

Thyroid Stimulating Hormone cause the release of T4, T3



- The thyroid is controlled by the hypothalamus and pituitary
- Through a feedback loop, the pituitary releases TRH (thyrotropin-releasing hormone) which stimulates the release of TSH (thyroid-stimulating hormone)
- TSH stimulates the thyroid gland to produce of the hormones T3, T4 to release into the blood

Thyroid gland

reminder: purpose

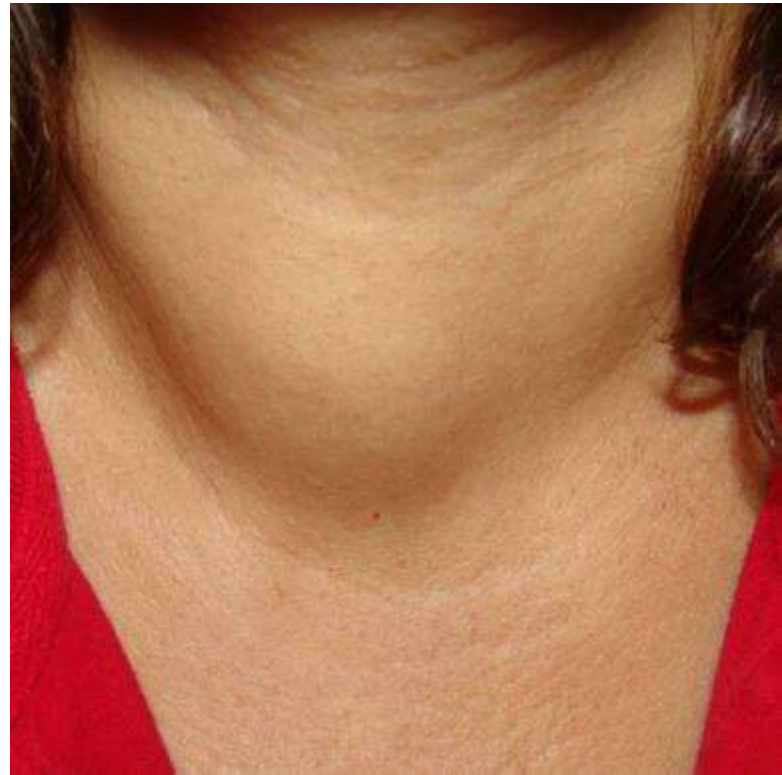


- General evaluation of health
- Diagnosis of disease or disorders of the thyroid gland
- Diagnosis of other systemic diseases that affect thyroid gland function

Thyroid gland

history-taking: patient's interviewing

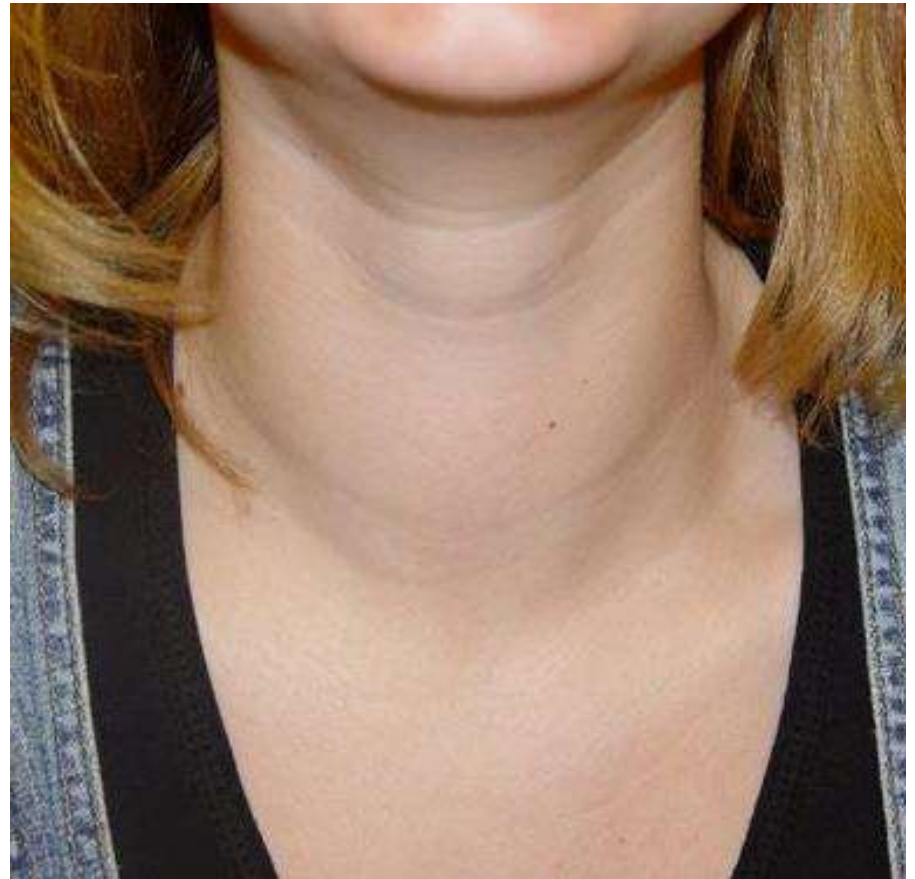
- gathering of information
- patient's narrative
- biomedical perspective
- psychosocial perspective
- context



Thyroid gland

clinical examination of the gland: inspection, palpation

- A normal thyroid is estimated to be 10 grams with an upper limit of 20 grams
- An enlarged thyroid is referred to as **a goiter**
- There is no direct correlation between size and function - a person with a goiter can be euthyroid, hypo- or hyperthyroid



Thyroid gland

clinical examination of the gland (inspection, palpation, their synthesis)



WHO classification of goiter' grade

- 0 - no palpable or visible
- 1 - palpable but not visible when the neck is in the normal position, thyroid nodules in a thyroid which is otherwise not enlarged fall into this category
- 2 - clearly visible when the neck is in a normal position and is consistent with an enlarged thyroid when the neck is palpated

Thyroid gland

patient's laboratory examination: Thyroid Panel

Blood

- Thyroid-Stimulating Hormone (TSH) evaluates overall thyroid function
- Total Thyroxine (T4) evaluates the total amount of T4 produced by the thyroid gland
- Free Thyroxine (T4) evaluates the amount of T4 available to the cells and tissues
- Free Tri-iodothyronine (T3) measures the amount of T3 (the active form of the hormone) available to the cells and tissues

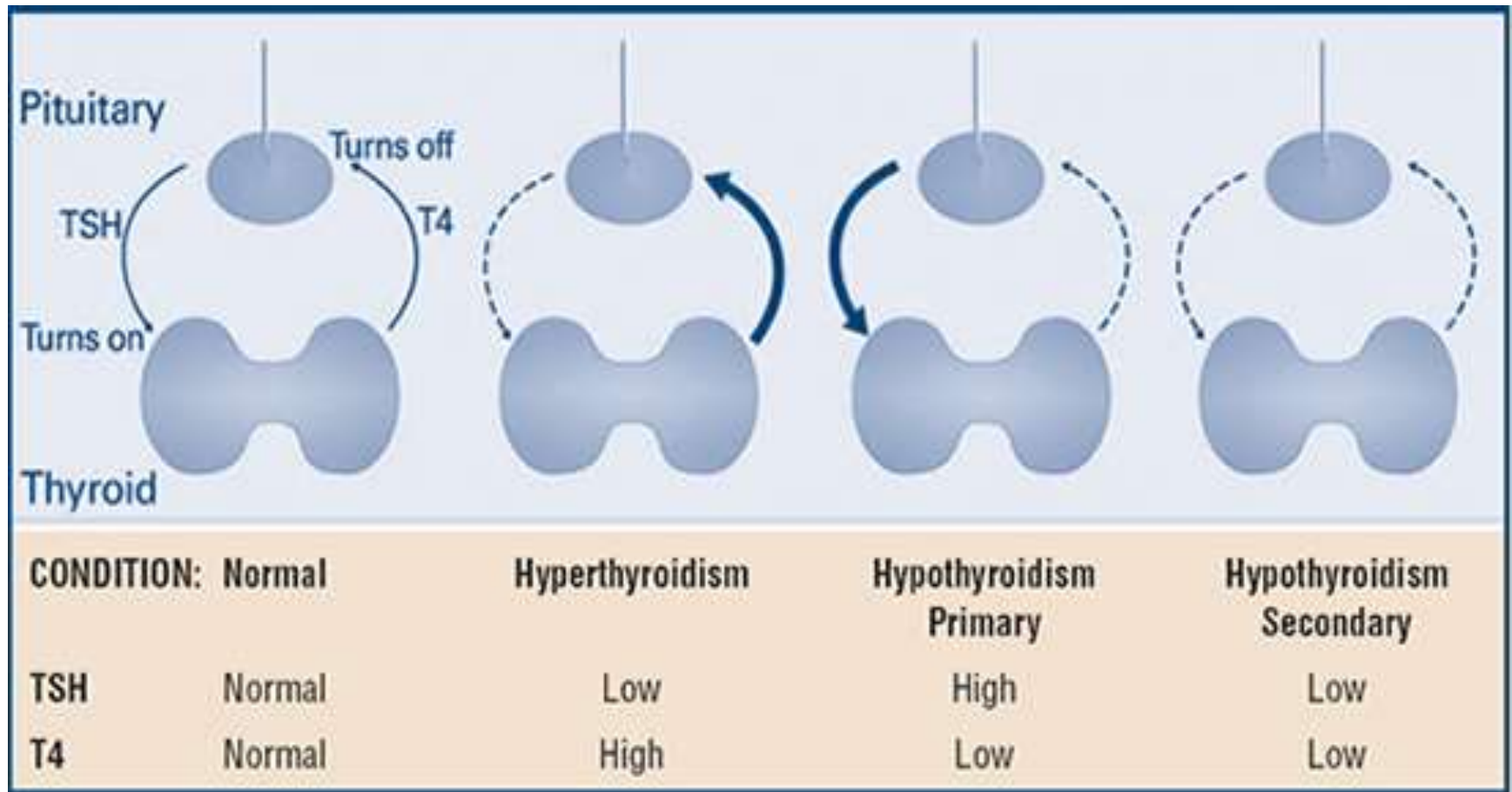
**Blood
Testing**



<https://www.youtube.com/watch?v=ua4uMumAOXI>

Thyroid gland

patient's laboratory examination : Thyroid Panel



Thyroid gland

patient's laboratory examination: Thyroid Panel

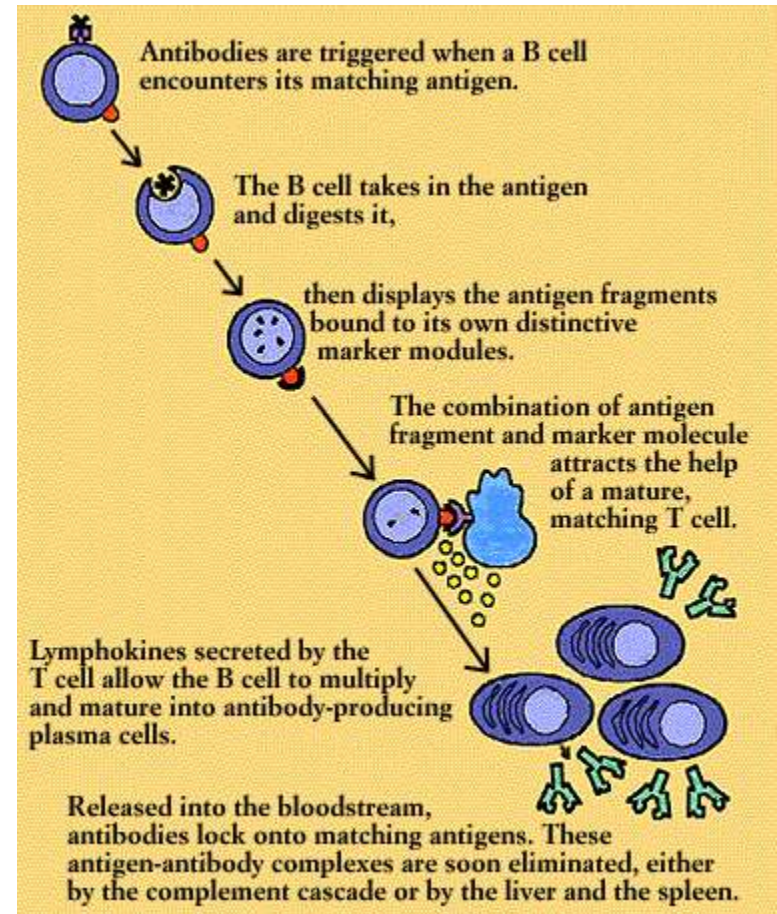
TSH	FREE T4 (FT4)	FREE OR TOTAL T3	PROBABLE INTERPRETATION
High	Normal	Normal	Mild (subclinical) hypothyroidism
High	Low	Low or normal	Hypothyroidism
Low	Normal	Normal	Mild (subclinical) hyperthyroidism
Low	High or normal	High or normal	Hyperthyroidism
Low	Low or normal	Low or normal	Non-thyroidal illness; rare pituitary (secondary) hypothyroidism
Normal	High	High	Thyroid hormone resistance syndrome (a mutation in the thyroid hormone receptor decreases thyroid hormone function)

Thyroid gland

patient's laboratory examination: Thyroid Antibodies

Blood

- Thyroid Peroxidase Antibody (TPOAb)
Thyroglobulin Antibody (TgAb)
- Thyroid Stimulating Hormone Receptor Antibody (TRAb)



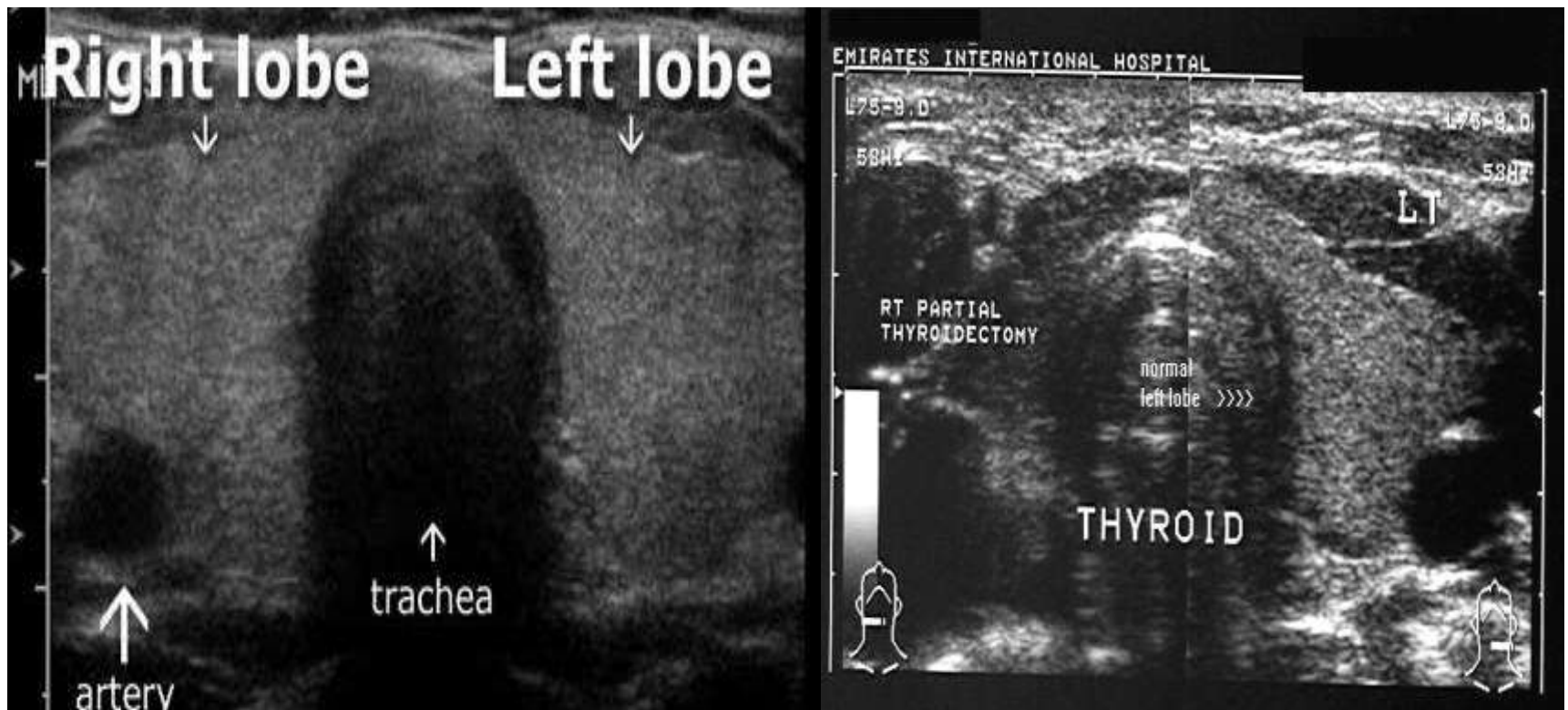
Thyroid gland

patient's laboratory examination: Thyroid Antibodies

THYROID ANTIBODY	ACRONYM	PRESENT IN	WHEN ORDERED	OTHER FACTS
Thyroid peroxidase antibody	TPOAb	Hashimoto thyroiditis; Graves disease	When a person has symptoms suggesting thyroid disease; when a doctor is considering starting a patient on a drug therapy that has associated risks of developing hypothyroidism when thyroid peroxidase antibodies are present, such as lithium, amiodarone, interferon alpha, or interleukin-2	Has been associated with reproductive difficulties, such as miscarriage, preeclampsia, premature delivery, and in-vitro fertilization failure
Thyroglobulin antibody	TgAb	Thyroid cancer; Hashimoto thyroiditis	Whenever a thyroglobulin test is performed to see if the antibody is present and likely to interfere with the test results (e.g., at regular intervals after thyroid cancer treatment); when symptoms of hypothyroidism are present	
Thyroid stimulating hormone receptor antibody, Thyroid Stimulating Immunoglobulin	TRAb, TSHR Ab, TSI	Graves disease	When a person has symptoms of hyperthyroidism; to monitor the effectiveness of anti-thyroid therapy	

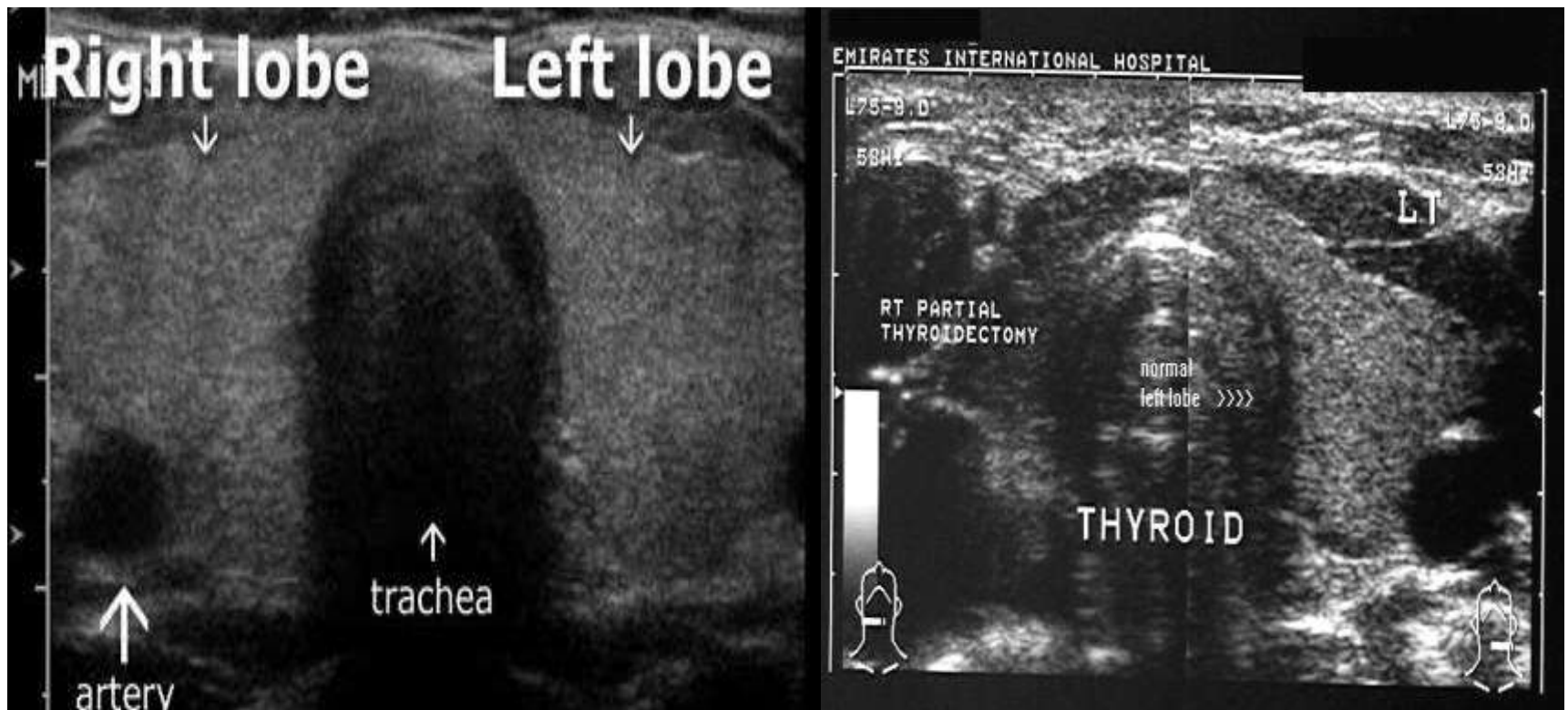
Thyroid gland

patient's instrumental examination: sonography



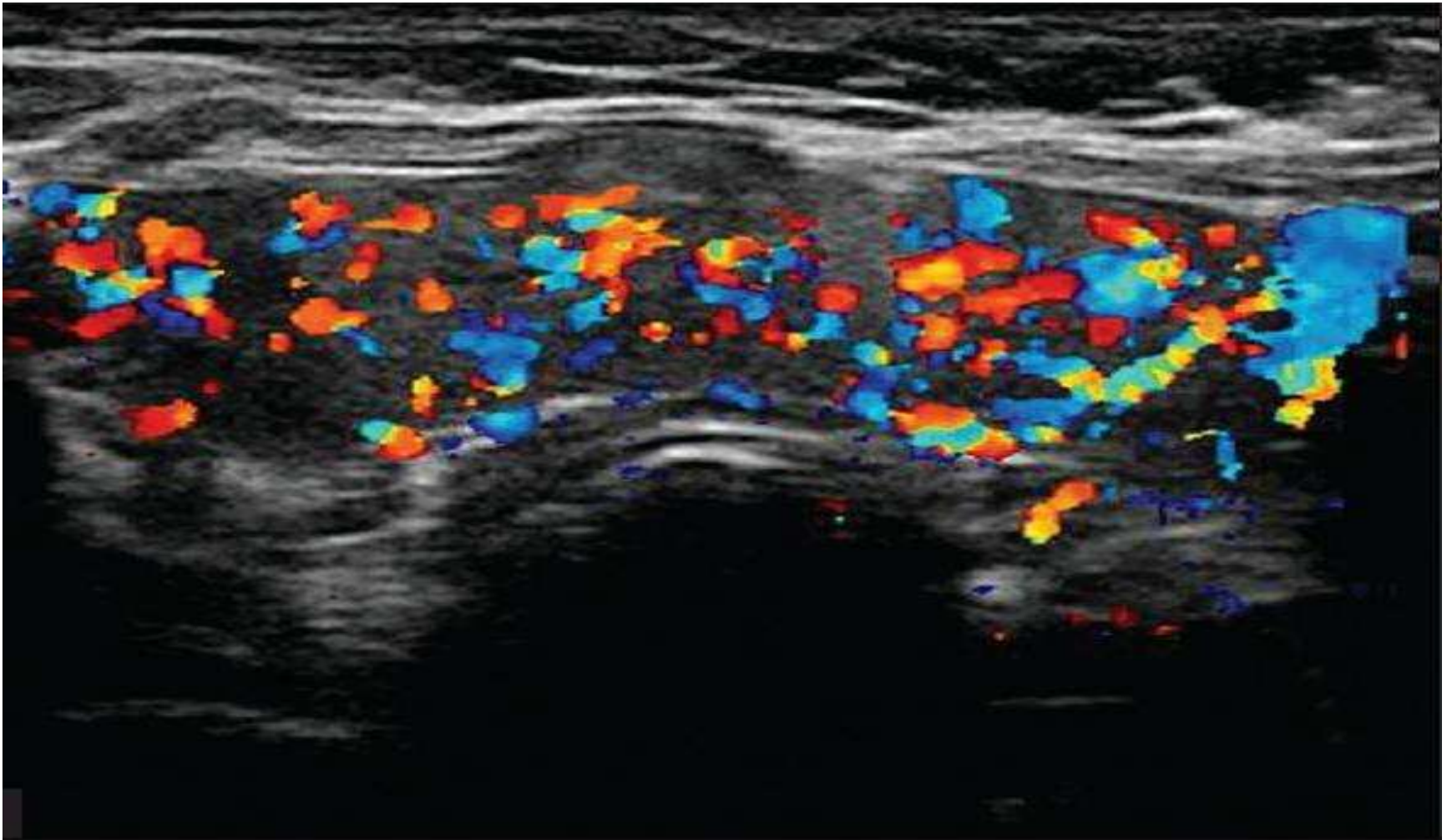
Thyroid gland

patient's instrumental examination: sonography



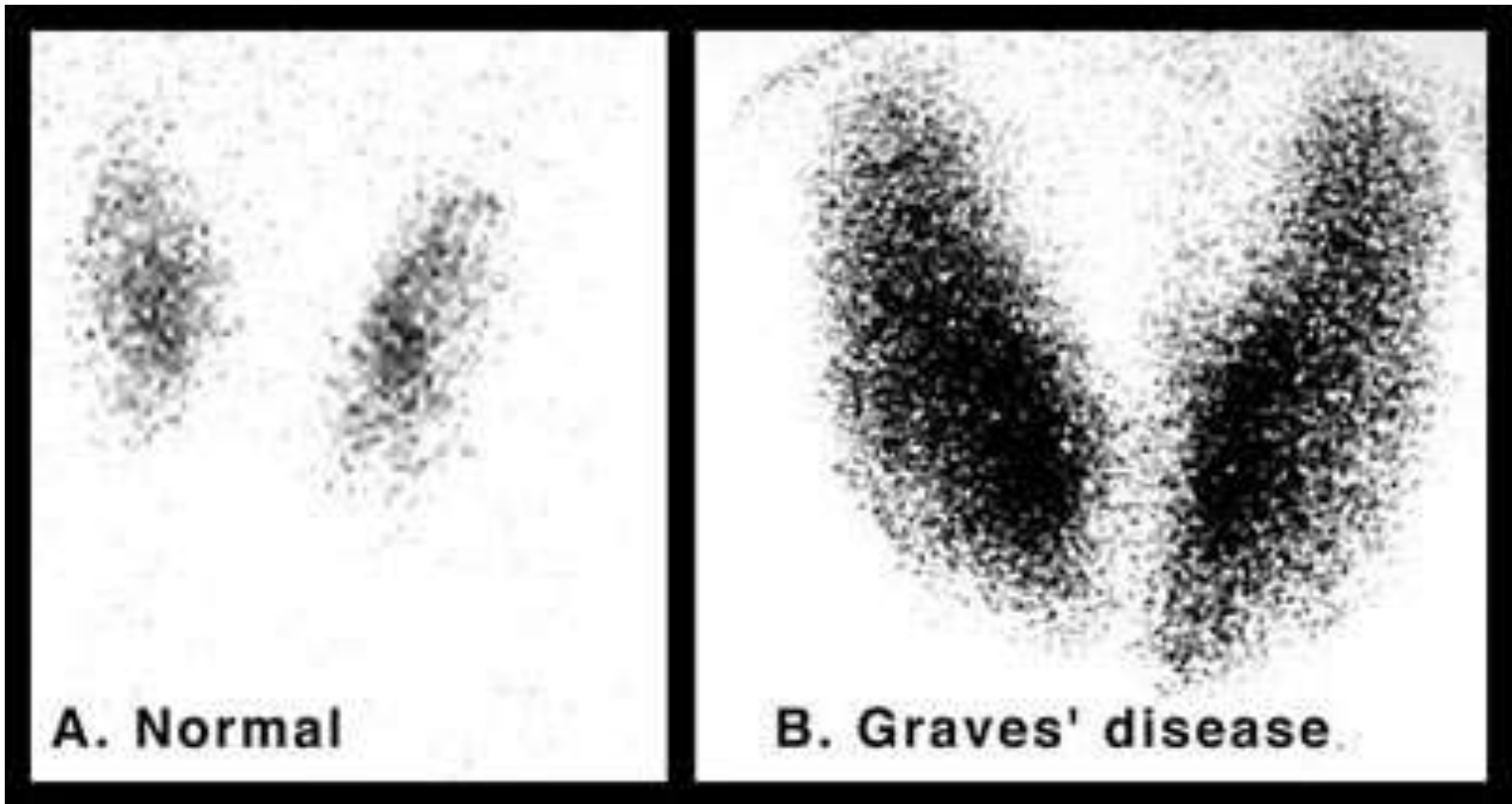
Thyroid gland

patient's instrumental examination: Doppler



Thyroid gland

patient's instrumental examination: scanning



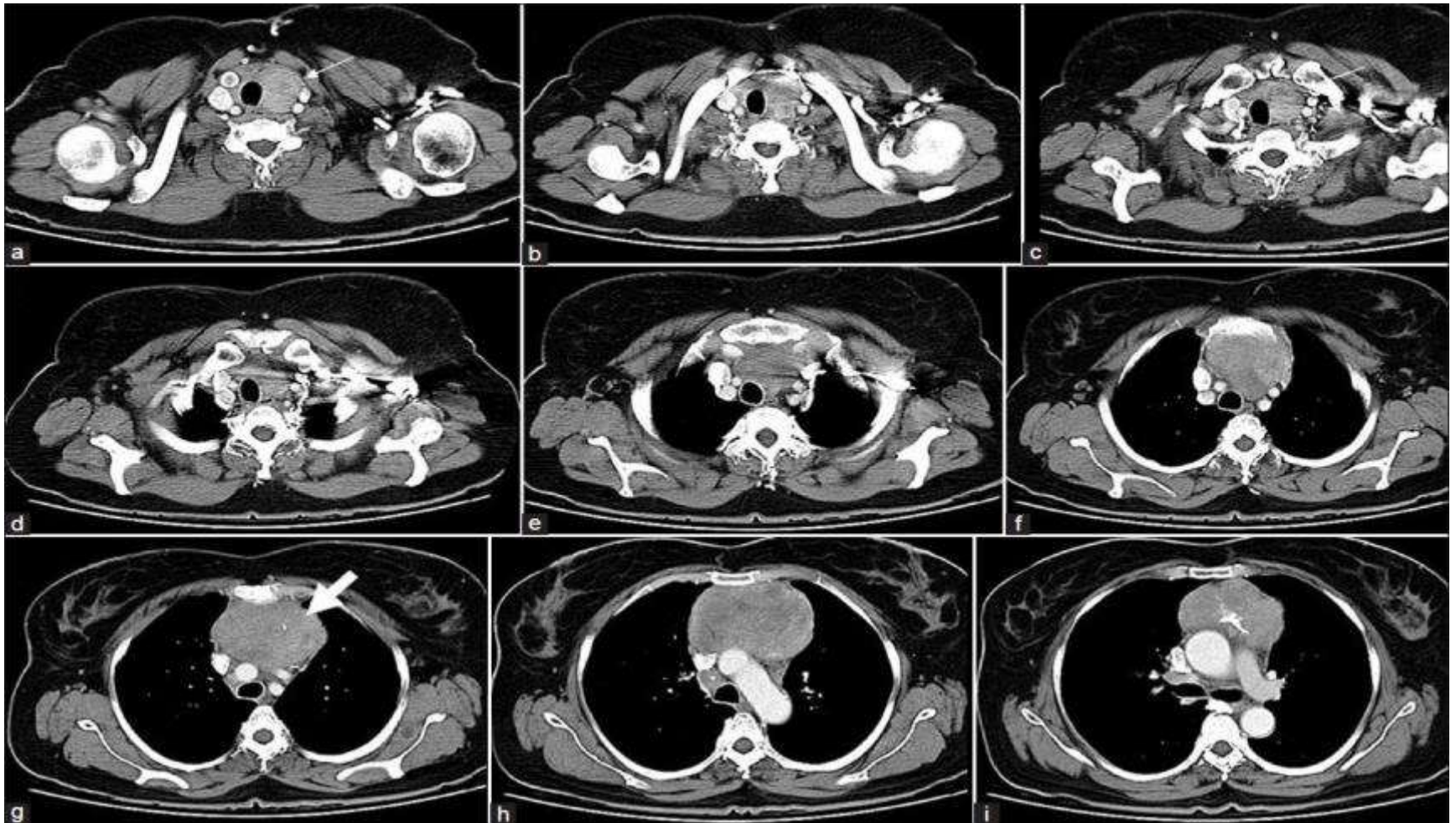
Thyroid gland

patient's instrumental examination: biopsy



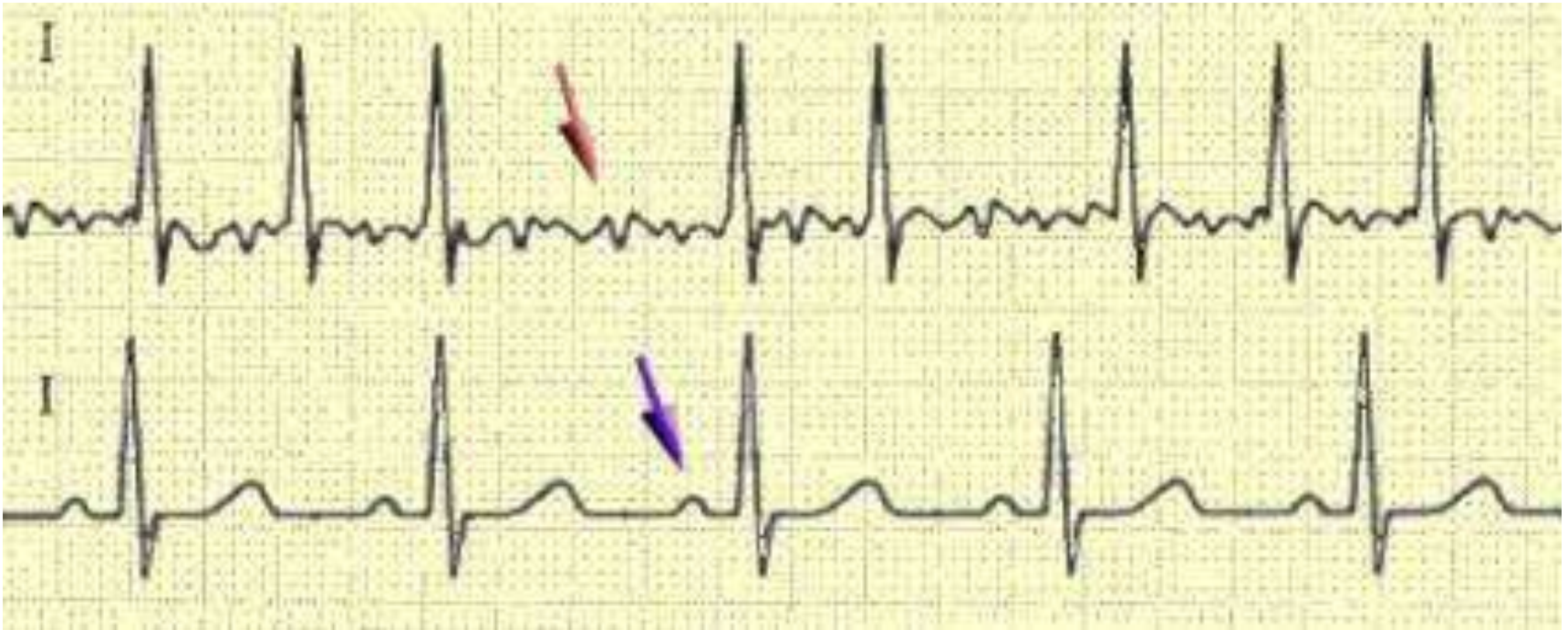
Thyroid gland

patient's instrumental examination: scan



Thyroid gland

patient's instrumental examination: ECG



Thyroid gland

hypothyroidism: etiology

- Primary

- Hashimoto's thyroiditis with or without goitre
- Radioactive iodine therapy for Graves' disease
- Subtotal thyroidectomy for Graves' disease or nodular goitre
- Excessive iodine intake
- Subacute thyroiditis
- Rare causes (Iodide deficiency, goitrogens such as lithium; antithyroid drug therapy, Inborn errors of thyroid hormone synthesis)

- Secondary

- Hypopituitarism
- Tertiary (hypothalamic dysfunction)
- Peripheral resistance to the action of thyroid hormone

Thyroid gland

hypothyroidism: age aspects

- Early onset (in childhood): delayed/incomplete physical and mental development (may be development of kretinism)
- Later onset (youth): impaired physical growth
- Adult onset (myxedema): gradual changes occur (tiredness, lethargy, decreased metabolic rate, slowing of mental function and motor activity, cold intolerance, weight gain, goiter, hair loss, dry skin, eventually may result in coma)

Thyroid gland

hypothyroidism: Midwest – the Goiter Belt

- During iodine deficiency, thyroid hormone production decreases
- TSH release increased (less negative feedback)
- TSH acts on thyroid, increasing blood flow, and stimulating follicular cells and increasing colloid production, but the only result is that the follicles accumulate more and more unusable colloid
- If goiter is due to decreased I, then thyroid gland enlarges (endemic or colloidal goiter)
- Cells eventually die from overactivity and the gland atrophies

Thyroid gland

hypothyroidism: clinical symptoms

- Cardiovascular (bradycardia, low voltage ECG, pericardial effusion, cardiomegaly, hyperlipidemia)
- Constipation, ascites
- Weight gain
- Cold intolerance
- Rough, dry, yellowish skin
- Puffy face and hands; hoarse, husky voice
- Respiratory failure
- Menorrhagia, infertility, hyper-, prolactinemia
- Renal (impaired ability to excrete a water load)
- Anemia (impaired Hb synthesis, Fe deficiency due to menorrhagia and reduced intestinal absorption, folate deficiency due to impaired intestinal absorption, pernicious anemia)
- Neuromuscular (muscle cramps, myotonia, slow reflexes, carpal tunnel syndrome)
- CNS (fatigue, lethargy, depression, Inability to concentrate)

Thyroid gland

hypothyroidism: diagnosis

- FT4↓ and TSH↑ (primary hypothyroidism)
- Serum T3 levels are variable
- positive test for thyroid autoantibodies (Tg Ab & TPO Ab) and an enlarged thyroid gland (Hashimoto's thyroiditis)
- FT4↓ & TSH inappropriately normal (myxedema)
- Absence of TSH response to TRH (pituitary deficiency)
- TSH↑ & FT4 & FT3 are normal (subclinical hypothyroidism)

MRI of brain is indicated if pituitary or hypothalamic disease is suspected

Thyroid gland

hypothyroidism: myxedema coma

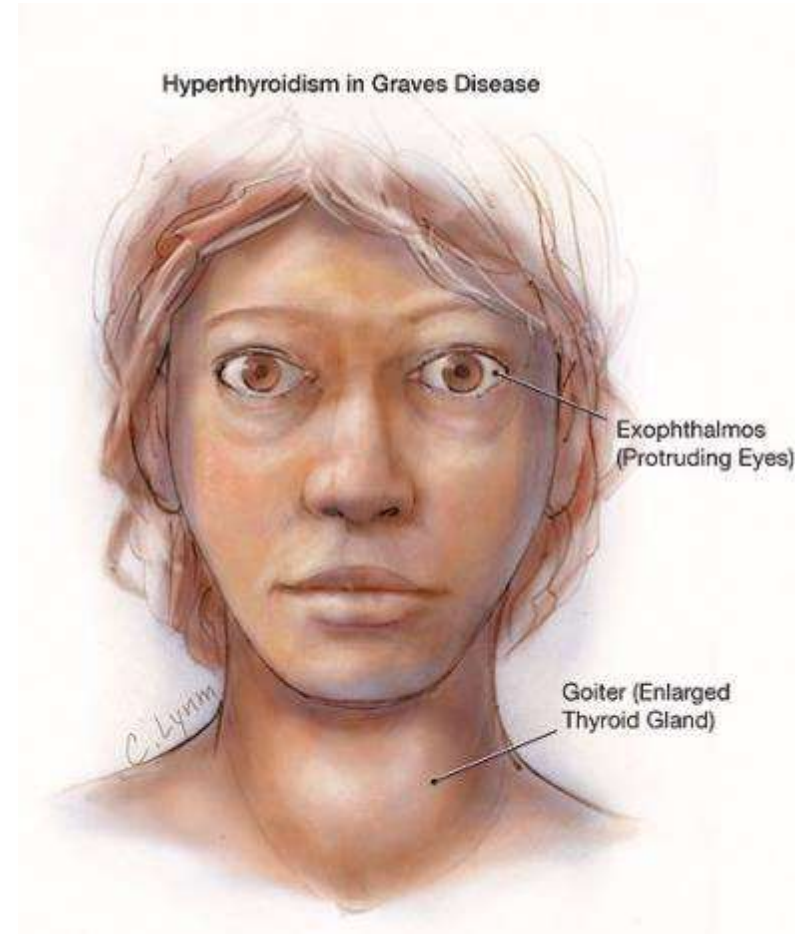
- Medical emergency, end stage of untreated hypothyroidism
- Progressive weakness, stupor, hypothermia, hypoventilation, hypoglycemia, hyponatremia, shock, and death
- The patient (or a family member) may recall previous thyroid disease, radioiodine therapy, or thyroidectomy
- Gradual onset of lethargy progressing to stupor or coma
- Marked hypothermia ($< 24^{\circ}\text{C}$)
- Heart failure, pneumonia, excessive fluid administration, narcotics
- ECG: bradycardia and low voltage
- $\text{FT}_4 \downarrow$
- , $\text{TSH} \uparrow$, normal, or \downarrow , cholesterol \uparrow or N, serum Na \downarrow



Thyroid gland

hyperthyroidism: etiology

- The second most prevalent endocrine disorder
- Effects women eight times more frequently than men
- May appear after an emotional shock, stress, or an infection
- **Graves' disease**: excessive output of thyroid hormones
- Other common causes of hyperthyroidism include thyroiditis and excessive ingestion of thyroid hormone (toxic adenoma, Plummer's disease (toxic multinodular goiter))



Thyroid gland

hyperthyroidism: clinical symptoms

Emotional (nervousness, irritability) Exophthalmos

Goitre (diffuse enlargement of thyroid, bruit)

Thyroid dermopathy (pretibial myxedema & TSH-R Ab↑)

Heat intolerance

Cardiovascular (palpitation, atrial fibrillation, CHF, dyspnea, angina)

Gastrointestinal (weight, appetite, diarrhea)

Reproductive (amenorrhea, oligo- menorrhea, infertility, gynecomastia)

Bone (Osteoporosis, Thyroid acropachy)

Neuromuscular (nervousness, tremor, emotional lability, proximal myopathy, myasthenia gravis, hyperreflexia, clonus, periodic hypokalemic paralysis)

Skin (pruritus, onycholysis, vitiligo, hair thinning, palmar erythema, spider nevi)

Thyroid gland

hyperthyroidism: diagnosis

- TSH ↓, High FT4↑ and/or FT3↑
 - If eye signs are present, the diagnosis of Graves' disease can be made without further tests
 - If eye signs are absent and the patient is hyperthyroid with or without a goitre, a radioiodine uptake test should be done
 - Radioiodine uptake and scan (diffuse increased uptake)
 - TSH-R Ab is specific for Graves' disease, may be useful in the "apathetic" hyperthyroid patient or who presents with unilateral exophthalmos without obvious signs or laboratory manifestations of Graves' disease

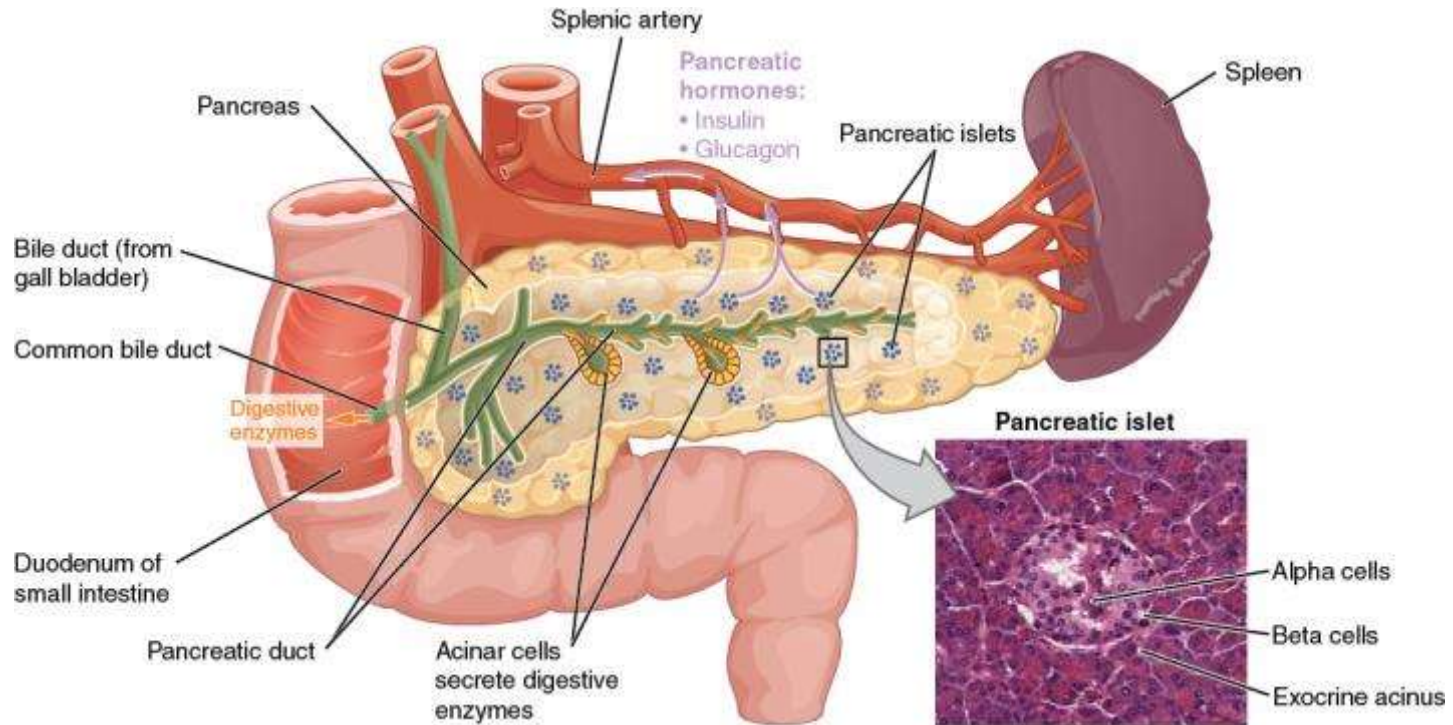
Thyroid gland

hyperthyroidism: thyroid storm (crisis)

- Occurs in a severely hyperthyroid patient caused by a precipitating event such as:
 - Infection
 - Surgical stress
 - Stopping antithyroid medication in Graves' disease
- Clinical clues
 - fever → hyperthermia
 - marked anxiety or agitation → coma
 - anorexia
 - tachycardia → tachyarrhythmias
 - pulmonary edema/cardiac failure
 - hypotension → shock
 - confusion

Endocrine pancreas

reminder: how does endocrine pancreas work



<https://www.youtube.com/watch?v=kIPYVV4aThM>

Endocrine pancreas

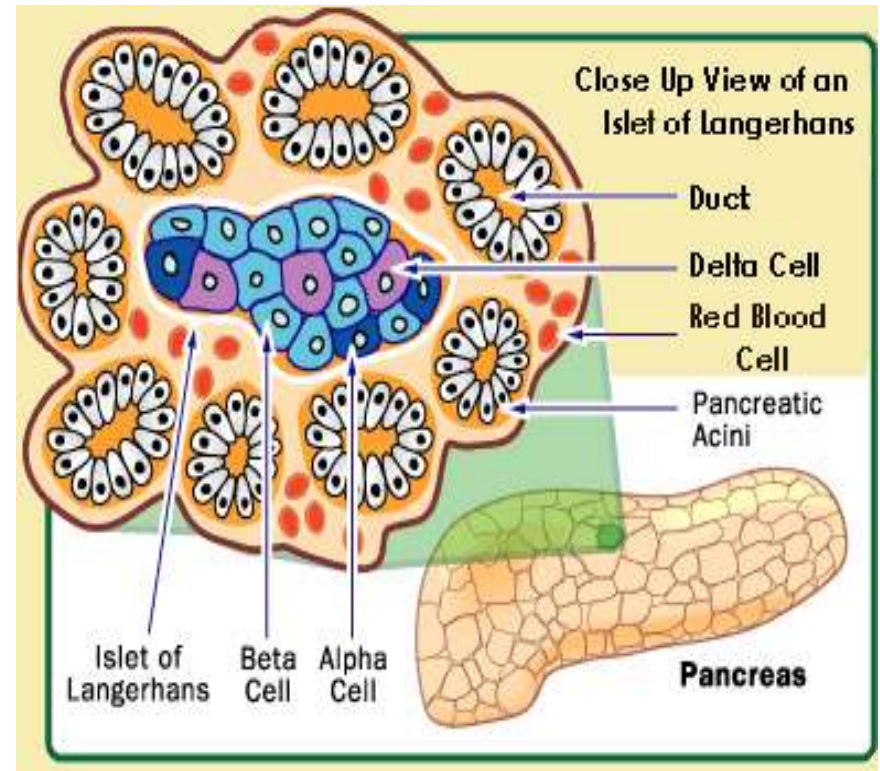
reminder: the primary functions

Production of pancreatic hormones by three cell types

- Glucagon by alpha cells
- Insulin by beta cells
- Somatostatin by delta cells

Hormones travel through the bloodstream to target tissues

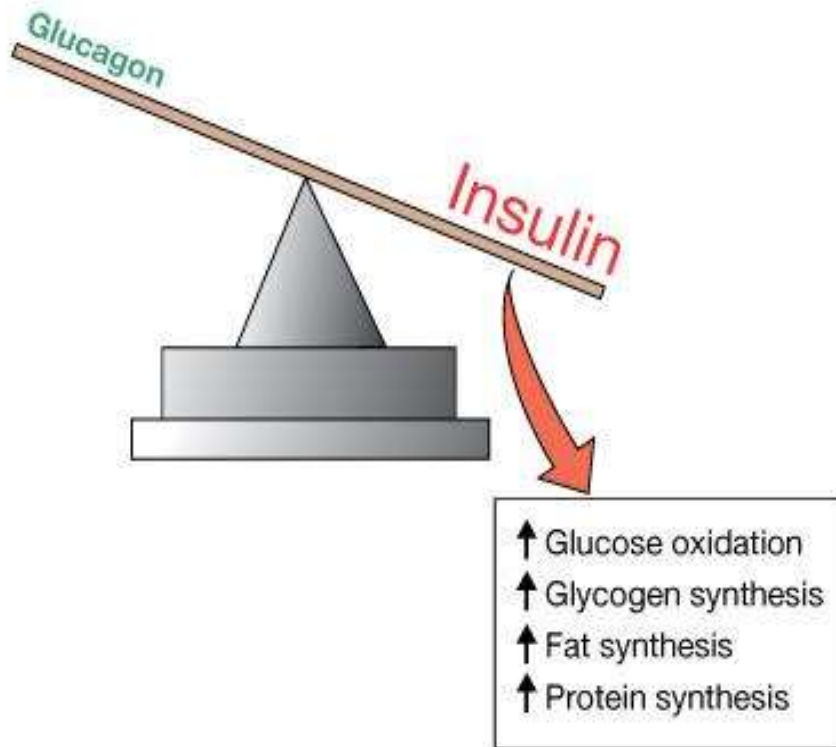
At the target cells, hormones bind specific receptors and cause cell changes that control metabolism



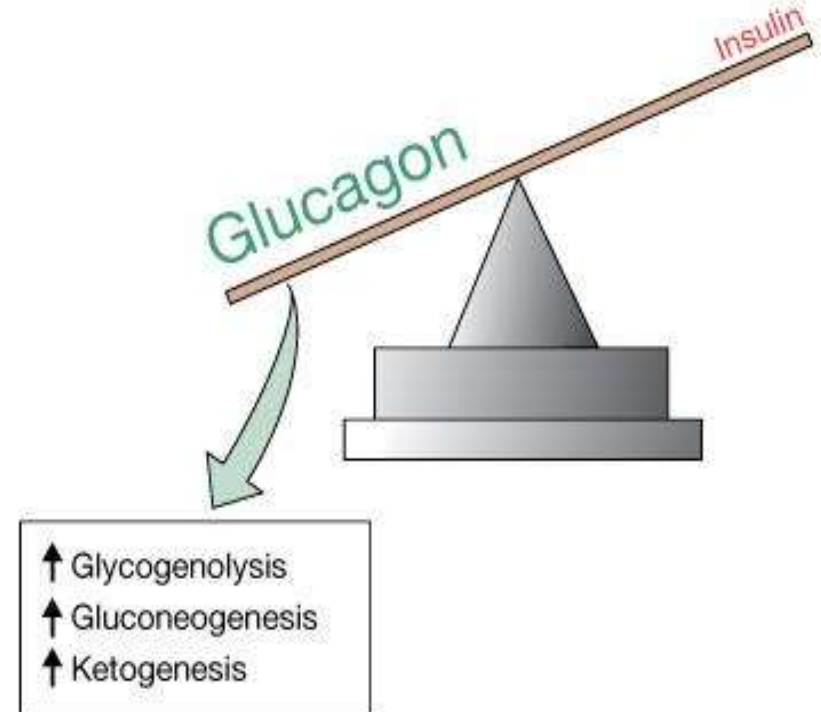
Endocrine pancreas

reminder: insulin & glucagon in glucose metabolism regulation

(a) Fed state: insulin dominates



(b) Fasted state: glucagon dominates



Endocrine pancreas

reminder: structure & roles of insulin

- Insulin is a polypeptide hormone, composed of two chains (A and B)
- Both chains are derived from proinsulin (prohormone)
- Chains are joined by disulfide bonds
- Acts on tissues to increase uptake of glucose and amino acids
- Increases glycogen production (glucose storage) in the liver and muscle
- Stimulates lipid synthesis from free fatty acids and triglycerides in adipose tissue
- Also stimulates potassium uptake by cells (role in potassium homeostasis).



Endocrine pancreas

reminder: insulin secretion control' mechanisms

- Chemically – high levels of glucose and amino acids in the blood
- Hormonally – beta cells are sensitive to several hormones that may inhibit or cause insulin secretion
- Neurally – stimulation of the parasympathetic nervous system causes insulin to be secreted
- Insulin secretion is decreased by decreased glucose and increased insulin concentration in blood and sympathetic stimulation
- Insulin transported through the blood to target tissues where it binds to target cells' specific receptors and acts as a biochemical signal to the inside of the cell: cell metabolism is stimulated

Endocrine pancreas

reminder: blood fasting glucose levels

- The normal range - a narrow range of about 3.9 to 5.5 mmol/L (as measured by a fasting blood glucose test)
- Hyperglycemia - high levels
 - Short term (physiological, pathological)
 - Persistent
 - impaired – pre-diabetes
 - high - esp. **diabetes mellitus (DM)**
- Hypoglycemia - low levels



Endocrine pancreas

reminder: purpose



- General evaluation of health
- Diagnosis of disease or disorders of endocrine pancreas
- Diagnosis of other systemic diseases that affect endocrine pancreas

Endocrine pancreas

history-taking: patient's interviewing

- gathering of information
- patient's narrative
- biomedical perspective
- psychosocial perspective
- context



Endocrine pancreas

clinical monitoring diabetic complications

Clinical Tests

NA	Blood pressure	Management; monitor hypertension and thus risk of heart disease
NA	Eye exam	Management; monitor onset and progression of eye disease
NA	Foot exam	Management; monitor onset and progression of nerve disease and peripheral arterial disease

Endocrine pancreas

patient's laboratory examination: indications for testing

The [American Diabetes Association](#) (ADA) recommendations:

- Obesity (BMI >25 kg/m²) – consider testing to detect pre-DM and type 2 DM in asymptomatic people
- Family history of DM in first- or second-degree relative
- Signs of insulin resistance or conditions associated with insulin resistance (eg, acanthosis nigricans, hypertension, dyslipidemia, low birthweight)
- Maternal history of DM or gestational diabetes mellitus (GDM) during gestation

Endocrine pancreas

patient's laboratory examination: diabetes panel

- Complete Blood Count (CBC)
- Glucose, Serum (Fasting)
- Oral glucose tolerance test (OGTT)
- Random blood glucose
- Islet cell antibody test (for type 1 diabetes)
- Hemoglobin A1c
- Diabetic Urinalysis

Testing



DIAGNOSIS OF DIABETES MELLITUS+сЛАЙД

The current WHO diagnostic criteria for diabetes should be maintained

- fasting plasma glucose $\geq 7.0\text{mmol/l}$ (126mg/dl)
or 2–h plasma glucose $\geq 11.1\text{mmol/l}$ (200mg/dl).

The glucose tolerance test – WHO criteria

	Normal	Impaired glucose tolerance	Diabetes mellitus
Fasting	$<7.0\text{ mmol/L}$	$<7.0\text{ mmol/L}$	$>7.0\text{ mmol/L}$
2 h after glucose	$<7.8\text{ mmol/L}$	$7.8\text{--}11.0\text{ mmol/L}$	$\geq 11.1\text{ mmol/L}$

HbA1c reflects average plasma glucose over the previous 2–3 months in a single measure which can be performed at any time of the day and does not require any special preparation such as fasting.

$\text{HbA1c} \geq 6.5\%$ = diabetes mellitus, $\text{HbA1c } 5.7 \text{ to } 6.4\%$ = pre-diabetes or at risk of diabetes.

Endocrine pancreas

patient's laboratory examination: diagnostic significance of glucose and hemoglobin A1c concentrations

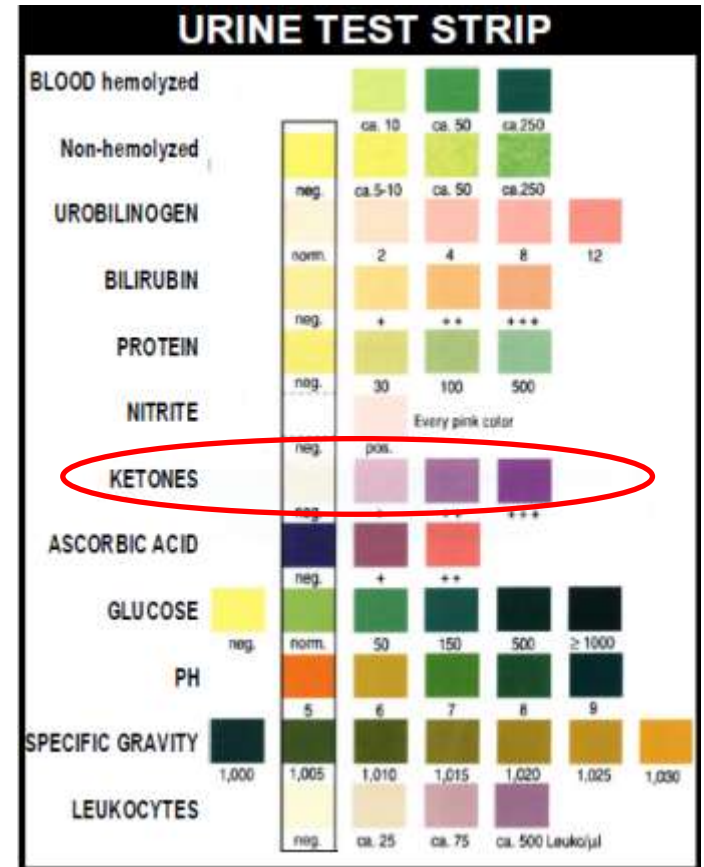
Individuals Suitable for Testing	Marker	Clinically Significant Level	Interpretation
Non-pregnant individuals with diabetes risk factors or age ≥ 45 years and pregnant women with risk factors (first prenatal visit)	FPG	≥ 126 mg/dL	Diabetes
	2-h OGTT (75 g)	≥ 200 mg/dL	
	HbA1c	$\geq 6.5\%$	
	FPG	100-125 mg/dL	Increased risk for diabetes
	2-h OGTT (75 g)	140-199 mg/dL	
	HbA1c	5.7%-6.4%	
All pregnant women (24-28 weeks of gestation)	2-h OGTT (75 g)	≥ 92 mg/dL	Gestational diabetes
	•Fasting	≥ 180 mg/dL	
	•1 h	≥ 153 mg/dL	
	•2 h		

FPG, fasting plasma glucose; OGTT, oral glucose tolerance test; HbA1c, hemoglobin A1c.

Endocrine pancreas

patient's laboratory examination: diabetic urinalysis

- Glucosuria can be detected when level of blood glucose exceeds more than 11mmol/l
- Urine tests can't be used to alone to confirm the diagnosis of diabetes mellitus
- They are ordered more often when there is suspicion on type 1 diabetes
- Laboratories can test urine for ketone bodies
- The body produces ketone bodies when fat tissue is used for energy instead of blood sugar
- If ketone bodies are present in the urine, this could indicate the high level of glucose in blood with insufficient level of insulin production



Endocrine pancreas

high level persistent hyperglycemia (DM): types

- DM type 1 results from the body's failure to produce enough insulin. Main risk factors: viruses and toxins that can affect genetically determined antigens of HLA system and cause autoimmune destruction of beta cells in the islets of Langerhans
- DM type 2 begins with insulin resistance, a condition in which cells fail to respond to insulin properly. As the disease progresses a lack of insulin may also develop. This form was previously referred to as "non insulin-dependent diabetes mellitus" (NIDDM) or "adult-onset diabetes". The primary cause is excessive body weight and lack of exercise
- Gestational diabetes, is the third main form and occurs when pregnant women without a previous history of diabetes develop a high blood glucose level

Endocrine pancreas

high level persistent hyperglycemia (DM):
early & later clinical symptoms

Classic

- Polyphagia (increased hunger)
- Polyuria (frequent urination)
- Polydipsia (increased thirst)

Other

- Blurred vision
- Fatigue
- Weight loss
- Poor wound healing (cuts, scrapes, etc.)
- Dry mouth
- Dry or itchy skin
- Impotence (male)
- Recurrent infections such as vaginal yeast infections, groin rash, or external ear infections (swimmers ear)

Endocrine pancreas

high level persistent hyperglycemia (DM):
early & later clinical symptoms

Early

- Frequent urination
- Increased thirst
- Blurred vision
- Fatigue
- Headache

Later (ketoacidosis)

- Fruity-smelling breath
- Nausea and vomiting
- Shortness of breath
- Dry mouth
- Weakness
- Confusion
- Coma
- Abdominal pain

Endocrine pancreas

high level persistent hyperglycemia (DM)

acute complications: diabetic ketoacidosis

- A potentially life-threatening complication happens in pts DM 1, it can occur in those with DM 2
- The symptoms usually evolve over the period of about 24 hours
- Predominant symptoms are nausea and vomiting, pronounced thirst, excessive urine production, and abdominal pain
- Breathing becomes labored and of a deep, gasping character (Kussmaul respiration)
- In severe cases there may be confusion, lethargy, stupor, coma
- On physical examination there is evidence of dehydration (tachycardia, low blood pressure), "ketotic" odor , and death
- Blood analysis will reveal significant decreased pH < 7.30 mmol/l
- Urine analysis will reveal significant levels of ketone bodies, often before other overt symptoms

Endocrine pancreas

high level persistent hyperglycemia (DM)

acute complications: nonketotic hyperosmolar state

- An acute complication sharing many symptoms with diabetic ketoacidosis, but an entirely different origin
- Water osmotically drawn out of cells into the blood
- The kidneys eventually begin to dump glucose into the urine
- Serum pH >7.30 , Bicarbonate >15 mEq/L, Small ketonuria and absent-to-low ketonemia (<3 mmol/L)
- Increased risk of blood clot formation
- If fluid is not replaced, the osmotic effect of high glucose levels, combined with the loss of water, will eventually lead to dehydration
- Some alteration in consciousness, lethargy may ultimately progress to a coma

Endocrine pancreas

high level persistent hyperglycemia (DM)

acute complications: nonketotic hyperosmolar state

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Endocrine pancreas

high level persistent hyperglycemia (DM)

acute complications: coma

- A life-threatening DM complication that causes unconsciousness
- Three different types :
 - Severe low blood sugar in a DM person
 - Diabetic ketoacidosis advanced enough to result in unconsciousness from a combination of a severely increased blood sugar level, [dehydration](#) and [shock](#), and exhaustion
 - Hyperosmolar nonketotic coma in which an extremely high blood sugar level and dehydration alone are sufficient to cause unconsciousness
- Diabetic coma was a diagnostic problem before the late 1970s, when glucose meters and rapid blood chemistry analyzers became universally available in hospitals

Endocrine pancreas

high level persistent hyperglycemia (DM)

acute complications: hypoglycemia

- A medical emergency that involves an abnormally diminished content of glucose in the blood
- Symptoms hypoglycemia usually do not occur until 2.8 to 3.0 mmol/L
- Adrenergic manifestations: shakiness, anxiety, nervousness, palpitations, tachycardia, sweating, pallor, coldness, clamminess, mydriasis
- Glucagon manifestations: hunger, nausea, vomiting, abdominal discomfort, headache
- Neuroglycopenic manifestations: abnormal thinking, depression, crying, exaggerated concerns, paresthesia, negativism, emotional lability, fatigue, weakness, apathy, lethargy, daydreaming, confusion, amnesia, blurred vision, automatic behavior, difficulty speaking, incoordination, motor deficit, paresthesia, headache, stupor, coma, etc.

Endocrine pancreas

high level persistent hyperglycemia (DM):
chronic complications

Microvascular

- Diabetic cardiomyopathy
- Diabetic nephropathy
- Diabetic neuropathy
- Diabetic retinopathy
- Diabetic encephalopathy

Macrovascular

- Coronary artery disease
- Diabetic myonecrosis
- Peripheral vascular disease
- Stroke

Other

- Gastrointestinal (gastroparesis, diarrhea)
- Genitourinary (uropathy/sexual dysfunction)
- Dermatologic
- Infectious
- Cataracts
- Glaucoma
- Periodontal disease

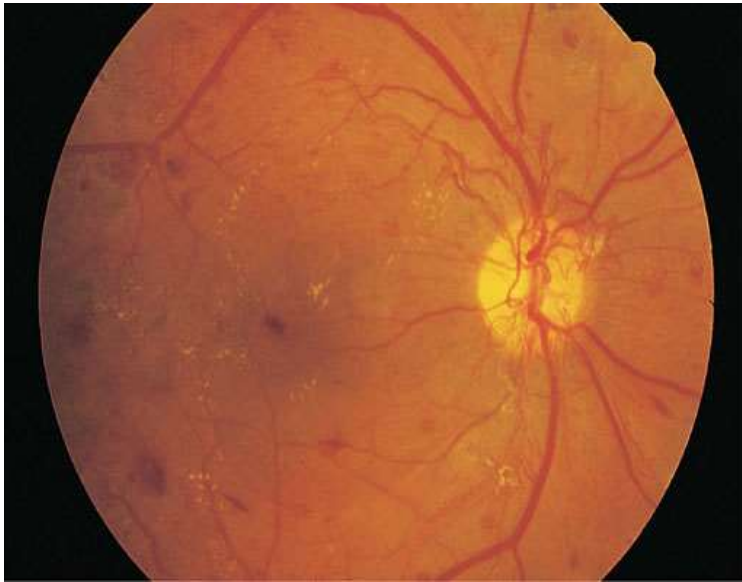
Endocrine pancreas

high level persistent hyperglycemia (DM):
main chronic complications



Endocrine pancreas

high level persistent hyperglycemia (DM):
main chronic complications



- Diabetic retinopathy results in scattered hemorrhages, yellow exudates, and neovascularization
- This patient has neovascular vessels proliferating from the optic disc, requiring urgent panretinal laser photocoagulation